THE

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'*Knowledge is proud that he has learned so much,*
Wisdom is humble that he knows no more.'—COWPER.

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Hygiene.

BY ALFRED CARPENTER, M.D., M.R.C.P. (LOND.).

HOW TO PREVENT DISEASE IN SCHOOL AND HOME (*continued.*)

Diphtheria (continued).—There is often much difficulty in settling the original source from whence this disease has extended. It sticks to houses in a most marked manner. It sometimes recurs year after year in the same situation. I know of a cottage in a secluded country lane in which the disease has appeared four times in succession within the last five years without any trace of its being introduced from some other place, after the third attack the family was removed. A year afterwards a second family who occupied the house suffered in the same way, although everything was done which was apparently possible for the removal of the germs in the house and its surroundings. Drains, cesspools, floors, ceilings, &c., were all attended to by the owner, who spared no expense to have them put right. The water supply was from a pump common to several families and was beyond suspicion. There was not any possible source of outside infection which could be detected. In this case it seems as if the only remedy could be by fire, for its conditions correspond with that of the houses described by Moses in Leviticus, Chap. XIV., verses 34 to 47, to which the disease called Leprosy seemed to cling, but which were evidently sewage sodden houses. The infectivity of the disease is very manifest under certain conditions. Yet we often meet with single cases in large households from which there is no extension, though the measures taken for isolation are marked by their absence; yet in other instances dozens arise in a most rapid manner which are clearly traceable to infection from case to case. A theory has lately been started that the germs for the reproduction of the disease may be preserved in the follicles of the tonsils, that a child having received the infection multiplies (for a long period of time) the mischief in those follicles. The throat continues relaxed, the tonsils enlarged, there is a catarrhal state of the nose, and without being laid up by the disease, the subject is growing the virus, and spreading it to unsuspicious but susceptible persons. The theory has not been proved, but it may be true, although it is not the only way in which it may spread, and whenever Diphtheria appears in a school or a family this class of case is generally found, and should be treated as suspicious by being put into quarantine.

Most of the measures which have been recommended for Small Pox and Scarlatina are necessary in this class also, but the greatest possible attention is to be given to the discharges from the throat and nostrils. That is the forcing pit in which the germs develope. All discharges from them should be burnt; rags, lint, linen of every kind which has been soiled with phlegm or any kind of discharge, should be cast into the fire. The room in which the patient is nursed should have a thoroughly carbolised atmosphere, and even in hot weather there should be a fire in the room, and the ventilation very carefully and thoroughly attended to. If all these points are looked after, the quarantine need not be severe. There is no occasion to exclude the necessary attendants, or shut them out from other parts of the house. Indeed, I believe that if the room is treated as I recommended, and the persons in charge of the patient are careful to wash their hands after going from the room, and their clothes have not been soiled by anything coming from the patient, that there is no danger in mixing with other people. Children should of course be kept away from the room. The stage of incubation for Diphtheria is not decidedly known, it may be very short, but it may also be very long. It is not prudent to allow a child who has had the disease to return to school until a long period has elapsed. It should be at least a month after all evidence of the effects of the disease has been removed from the throat, and the kidneys are quite healthy as evidenced by a chemical examination of urine, especially when there has been a thickening or enlargement of the tonsils.

There is no remedy against infection which can in any way equal sulphur flour and a little diluted sulphurous acid. I am accustomed to treat the throat as the gardener does the grapes in the vinery when attacked by the oidium disease. Dust over the tonsils and palate with fine sulphur powder, snuff it up the nose, mix it with honey and apply it as a paint, and also wash out the mouth, and gargle with a weak

BRITISH MUSEUM

solution of sulphurous acid. If there are any sloughs in the throat use a little charcoal in fine powder mixed with a little sulphur, dusting the slough with it and the offensive breath will disappear, the room becoming fit for the nurses to stay in very soon after such treatment has been adopted, all other measures are only half measures in dealing with the infectivity of this dire disease. If the disease is fatal, the body should be enclosed in a shell as soon as possible, treated with sulphur powder in the mouth and throat, some of it being blown up the nostrils, whilst abundance of peat charcoal should be placed in the coffin round the throat and under the neck; a thin layer of it being spread upon the floor of the coffin before the body is placed in it. The face should be covered over with a mixture of powdered charcoal and sulphur before the lid is secured, and it should not be opened again. This plan is also the right one to be adopted when the death has been caused by small pox or erysipelas, and in a minor degree, as far as regards the peat charcoal, when death has been caused by any infectious disease.

If *Cremation* should ever become an institution in this country, it will be brought about by the necessity which exists for its use in thickly peopled districts when death has been caused by Diphtheria and Small Pox. It is quite possible that the usual method of interment in deep graves is not perfectly free from danger to those who come after us. Cremation does destroy all possible source of mischief in such cases, and is fully justifiable, nay I am not sure that it ought not to be insisted on. There are circumstances connected with the vitality of the resting spore of some of this class of disease which seems to point out that burial of the dead is unsafe unless the most stringent means are taken to ensure the destruction of the virus. Sulphur and charcoal powder will in time cause that destruction, and should be always used, but Cremation is the most certain means that could be adopted.

This disease is most fatal in close ill ventilated positions, and in houses closely shut in by trees. It also attacks those who are exposed to steam from heated drains or miasms from badly kept earth closets. These classes are most susceptible, and whilst Scarlatina is more common in towns and on lines of sewers, Diphtheria is more fatal in country places were sewers only belong to a few or one house, especially in connection with ill ventilated and damp school houses in which the soil has been allowed to become sewage soaked or saturated with decomposing organic matter. The disease is sometimes found in the very cleanest houses, it seems also as if some families were more susceptible than others, but it is nevertheless essentially a filth disease. After the body has been removed if the case has been fatal, or after the family have been cleared out and the house emptied, those articles which will bear boiling or steaming should be so treated. Articles of furniture, &c., which will not bear steam or hot water, but will not be injured by a temperature of 300° of dry heat may be baked. Such things as cannot be baked should be left in the room, the room closed, and bisulphide of carbon or stick sulphur burnt in it as directed in the case of Scarlatina, carefully keeping the room closed for 24 hours. It should then be thrown open to air and sunlight as much as possible, the ceilings and walls lime-washed, the floors and lower parts of the walls washed with carbolic soap and water, and after that washed down with a solution of Mercuric Chloride (corrosive sublimate) of a strength of one part in 1000 of water. This is a virulent poison and must be used with judgment, but it utterly destroys all living organic matter with which it comes in contact. It will not be of much use if the floors are soaked with albuminous or alkaline matters, for the salt is at once decomposed by such things. It is to be used therefore after everything has been thoroughly cleansed and dried again. It is extremely rapid in its action, and is the only known disinfectant which destroys the most resistent organisms in a short space of time. The whole of the drains attached to the house should be well flushed out and the sewage obtained from the flushing should be mixed with earth and utilised for the growth of vegetable matter as soon as possible. After the drains, catch pits, traps, or other places in which sewage has been received, have been washed out, they should be flushed down with a solution of green Copperas (Sulphate of Iron). This salt is sometimes used to disinfect sewage itself. It requires from 20 to 30 grains for each gallon acted upon. A pound of the salt is sufficient for about 250 gallons of sewage, but it is wasteful, and to my mind it is better to mix a pound of the salt dissolved in 9 gallons of water, and use the solution as a wash down after the sludge, &c., has been flushed away. If all catch pits, traps, urinals, and other places which have been receptacles for sewage have been treated as directed it will be a marvel if there is a recurrence of disease from any preceeding case. It is however to be borne in mind that the very measures which are taken to disinfect are also measures which may preserve by destroying all the micrococci upon whose activity destructive agencies depend, and leaving those upon which disease depends unmolested. It has been seen that sputum containing germs upon which the propogation of diphtheria depends, may retain its virulence because it has not been touched by the poison, but all the agents which would otherwise have destroyed it have been killed. Dried sputum which has been kept for three months in carbolised material has exhibited its virulence at the end of that time. It may be therefore that a careless application of disinfectants by covering up the germs of disease, may preserve them from destructive agencies, and lead to the reproduction of the disease at unexpected times. Excessive cleanliness is therefore required, it is possible that the sputa of this class of case may have escaped in some crack in the floor, or wall, it may be preserved by the materials used, and so our very care may have led to further trouble. I press this question of cleanliness upon all who are engaged in disease repression as the first canon law of the case.

Measles and Hooping Cough.—These diseases are so often in unionism that their hygienic treatment might be considered together, but there are some differences which require consideration.

Measles has a long stage of incubation; 14 days often elapses after exposure. The infective germs are easily wafted through the air and may be carried for considerable distances. Children with measles or hooping cough on one side of a street may infect children on the other side, though no intercourse has existed between the inhabitants themselves. As regards hooping cough we do not know how long it is incubating. Fortunately it is not a very fatal disease, although its advent may be ushered in with convulsions, or there may be acute

bronchitis or inflammation of the lungs, in which case life is in jeopardy, but this class of case is generally coincident with severe weather. Fresh air and cool rooms in summer, warm rooms in winter with free ventilation are the essentials of hygenic treatment. The removal from the room of all woollen articles which may retain the infection, and a moderately carbolised atmosphere is all that is necessary. The disease is easily caught, but its effects are evanescent, the virus does not retain its vitality for any long period and a lengthened quarantine is not necessary. Its long stage of incubation is its most serious difficulty in regard to repression.

(*To be continued.*)

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Popular Mythology.

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[These papers are designed for our youngest readers. Used as themes for composition work, they will be found invaluable.]

CHAPTER VIII.

ARGOS PANOPTES [ARGEIPHONTES].

ARIADNE [THESEUS].

ARION [AREION].

ARISTAIOS, ARISTÆUS, is said to be a son of Apollon and of the Libyan nymph, Kyrênê, whose name points to the horned sun. He is described by Virgil in his 'Georgics' as skilled in the management of bees, and is possessed of the secret of producing them, a secret learnt from the water-god PROTEUS.

ARTEMIS is, in some traditions, the twin-sister of APOLLON; in others she is born so long before him that she can aid her mother Leto at his birth. Thus, like Phœbus, she is born in Delos, or Ortygia, the quail-land, or land of morning [ARETHUSA]. She is one of the three deities (the other two being Athene and Hestia) over whom, in their unsullied purity, Aphrodite has no power. Like her mighty brother, she has the power of life and death; she can remove the plagues which torment mankind, or if her anger be roused by neglect she can inflict them. It is at her bidding that the Kalydonian boar ravages the fields of Oineus, and brings about the great hunt in which the Achaian chieftains are banded together like the ARGONAUTS. It is because she is offended that IPHIGENEIA is sacrificed in Aulis; and it is she who gives to Prokris the unerring spear which is destined to lay her low in the thicket where the dewdrop glistens longest. In the west Artemis was supposed to have her home especially in Arkadia, the bright land, whose city Lykosoura (the trail of light) was the first on which the sun had ever looked. But here she seems to belong to, or to spring from, the running waters, for she demands from Zeus an attendant troop of fifty Okeanid and twenty Amnisiad (or river) nymphs [APSARAS]. With these she chases her prey on the Arkadian mountains, where Pan, the breeze whispering among the reeds, furnishes her with dogs, the clouds which hurry across the sky, driven by the gentle summer winds.

But when we get to Sparta we find the worship of a deity known as Artemis Orthia, a worship so different in spirit from that of the Greek tribes generally, that we are justified in suspecting that we have here a worship imported, like that of DIONYSOS, POSEIDON, and ADONIS, from abroad. The Spartan Artemis may, or may not, be the same as the Artemis worshipped under the names Tauria or Tauropola; but she is a mere demon, glutted with human blood. In her honour Spartan youths and maidens were scourged before her alters, often until they died. There can be little doubt that we have here simply the Ephesian Artemis, a deity closely akin to Moloch, the sun-king, to whom Syrians, Canaanites, and Jews sacrificed their children, as the Psalmist indignantly complains that they offered their sons and their daughters unto devils, and the land was defiled with blood.

ARTHUR, in old British tradition, the king who defends Britain against its enemies, gathers round him a great company of redoubtable knights or warriors, and is slain at last by his son Mordred. The story, when examined, is seen to be identical in all its essential features with many mythical stories of Greek and other tribes. He is one of the many who, though in lowly condition, are born to be kings. At his birth, the story of which is the same as that of the birth of Herakles, he is wrapped in a cloth of gold and placed in the hands of a poor man, in whose house he grows up a model of human beauty. Like Cyrus, Romulus, and others in the same plight, he cannot long abide in his humble station. Some one must be chosen king, and there is seen in the churchyard a great stone with a mighty sword stuck fast in it, and bearing the inscription, 'Whoso pulleth this sword out of this stone is rightwise born king of England.' The sword will not yield to the utmost efforts of others; it yields to the first touch of Arthur's hand. This is precisely the story of THESEUS and of SIGURD. As in the case of Cyrus, the knights scorn to be governed by a boy whom they hold to be baseborn; but they are compelled to abide by the ordeal of the stone, and Arthur forgives them all. But this weapon, great as it is, is not to be the blade with which Arthur is to perform his most wonderful exploits. Like the sword of Odin in the VOLSUNG lay, it is snapped in the conflict with Pellinore: but it is brought back to him in the form of Excalibur.

Arthur's wife is Guenevere, who brings as her dower the round table, which is possessed of the mysterious power of furnishing banquets at will for the knights belonging to it. It is, in short, one of those vessels of plenty whose abundance is inexhaustible [AMALTHEIA]. In this respect it answers to the Holy Grail, SANGREAL, the difference being that of the latter only the pure in heart can be partakers. Guenevere herself is the Helen of the story, and her relations with Lancelot answer to those of Helen with the Trojan Paris. She is said from the first to be a wife not wholesome for Arthur, and she is, like Helen, born to bring misery on herself and on all around her.

Possessed of Excalibur, with its scabbard, Arthur is invulnerable; but the Fay, or Fairy Queen, Morgan, succeeds in getting the scabbard, which she throws into the lake, and Arthur may now both bleed and die. Another maiden brings him a robe like that which MEDEIA gives to Glaukê at Corinth; but Arthur,

being forewarned, refuses to put it on until he has seen the bringer wear it. This he makes the maiden do, 'and forthwith she fell down and was burnt to coals.' It would, indeed, take long to give all the incidents in the Arthur story which reproduce incidents in other traditions of the Aryan nations.

At last Arthur is assailed by the hosts of Mordred, who deal him a fatal blow. But neither he nor others can think that he is really dying. He goes, as he says, to Avilion, to heal him of his grievous wound; and there, it was thought, he slept until, like OLGER the Dane, he should come forth to smite once more the enemies of his country.

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Easy Steps in Trigonometry.

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ANSWERS AND HINTS TO SOLUTIONS.

CHAPTER VIII.

1. $\text{Sin A} + \text{sin B} = 2 \sin \frac{A+B}{2} \cos \frac{A-B}{2}$. Form. B.

$\text{Sin (A + B)} = 2 \sin \frac{A+B}{2} \cos \frac{A+B}{2}$. Form. 6.

$\therefore \text{Sin A} + \text{sin B} + \text{sin (A + B)} = 2 \sin \frac{A+B}{2} \left(\cos \frac{A-B}{2} + \cos \frac{A+B}{2} \right)$

$= 4 \sin \frac{A+B}{2} \cos \frac{A}{2} \cos \frac{B}{2}$. Form. F

2. As in 1 use Form. F and 6.

3. Resolve left hand member (L. H. M.) into factors. Reduce the factors by Form. B, D, and then apply Form. 6 twice.

4. Apply to two of the terms in L. H. M. Form. B, and Form. 6 to the other. Collect and apply Form. H.

5. Apply to both members Form. A. Eliminate the term common to both sides Apply Form. 6 to sin $16x$. Resolve into factors. Equate both factors to zero.

Ans. $\text{Sin } 8x = 0 \quad \therefore 8x = 0$ or 180 &c., or $\cos 8x = \frac{1}{2}$
$\therefore 8x = 60°, 300°$, &c.

6. Apply to numerator Form. D, and to denominator Form. H, and cancel, &c.

7. Resolve L.H.M. into factors; apply Forms. F, H, and 6 (twice).

8. $\text{L.H.M.} = \frac{2 \sin (x+y) \cos y + \sin (x+y)}{2 \cos (x+y) \cos y + \cos (x+y)}$
$= \frac{\text{Sin } (x+y) (2 \cos y + 1)}{\text{Cos } (x+y) (2 \cos y + 1)}$ &c.

9. $\text{L.H.M.} = \frac{\text{Sin } 3x \cos x}{\text{Sin } x \cos 3x}$ apply Forms. A and C.

10. $\text{L.H.M.} = \left(\frac{2 \sin x + \sin x - \sin 3x}{2 \cos x + \cos x + \cos 3x} \right)^2$
$= \left(\frac{2 \sin x - 2 \sin x \cos 2x}{2 \cos x + 2 \cos x \cos 2x} \right)^2$

Resolve into factors, &c.

$\text{R.H.M.} = \left(\frac{1 - \cos 2x}{1 + \cos 2x} \right)^2$

Hence both can be shown $= \tan^6 x$.

11. Reduce tan x and cot $2x$ by Forms. 4, 5. Add, resolve into factors, and apply Form. 9.

12. $\text{L.H.M.} = \frac{\sin A \cos B + \cos A \sin B}{\cos A \cos B} - \tan (A + B)$
$= \frac{\text{Sin } (A+B)}{\text{Cos A cos B}} - \frac{\sin (A+B)}{\cos (A+B)}$ Form. 11, 4
$= \text{Sin } (A+B) \left(\frac{\cos (A+B) - (\cos A \cos B}{\cos A \cos B \cos (A+B)} \right)$
$= -\tan (A+B) \frac{\sin A \sin B}{\cos A \cos B}$ &c. Form 12.

13. Apply Form. F. Reduce cos C to $-\cos (A + B)$, and then apply Form. 9, H, &c.

14. $\frac{a}{b} = \frac{\sin A}{\sin B}$
$\frac{a-b}{a+b} = \frac{\sin A - \sin B}{\sin A + \sin B}$ apply Form. D, B, &c.

15. Tan $\frac{A+B}{2}$ in 14 can be shown $= \cot \frac{1}{2} C$, hence &c.

16. $\text{L.H.M.} = \frac{\cos 3A - \cos A - \cos A}{\sin 3A + \sin A + \sin A} \tan A$, apply Forms. H, B, 4, &c.

17. $\text{L.H.M.} = \frac{2 (\cos 2A - 1) - 1}{2 (\cos 2A + 1) + 1}$ apply 10, 9, &c.

18. $\frac{a}{b} = \frac{\cos \theta}{\cos \phi} \therefore \frac{a+b}{a-b} = \frac{\cos \theta + \cos \phi}{\cos \theta - \cos \phi}$ apply Forms. F, H, 5

19. Reduce $\sin \theta + \sin 3\theta$ by Form. B. Resolve into factors, &c.

20. Expression $= 2 \left(2 \sin \frac{\phi}{2} \cos \frac{\theta}{2} \right)^2$
$= 2 \left(\sin \frac{\phi + \theta}{2} + \sin \frac{\phi - \theta}{2} \right)^2$ Form. A
$= 2 \sin^2 \frac{\phi + \theta}{2} + 2 \sin^2 \frac{\phi - \theta}{2} + 4 \sin \frac{\phi + \theta}{2} \sin \frac{\phi - \theta}{2}$
$= 2 \sin^2 \frac{\phi + \theta}{2} + 2 \sin^2 \frac{\phi - \theta}{2} + 2 \cos \theta - 2 \cos \phi$ Form. G.

21. To L.H.M. apply Form. 6.
In R.H.M. resolve into factors and apply Form. 10.

22. Reduce to sines and cosines. Simplify. Apply to denominator Form. 14, &c.

23. Proceed as in 22.

24. Add the two R.H.M. of 22 and 23, and apply Form. 14.

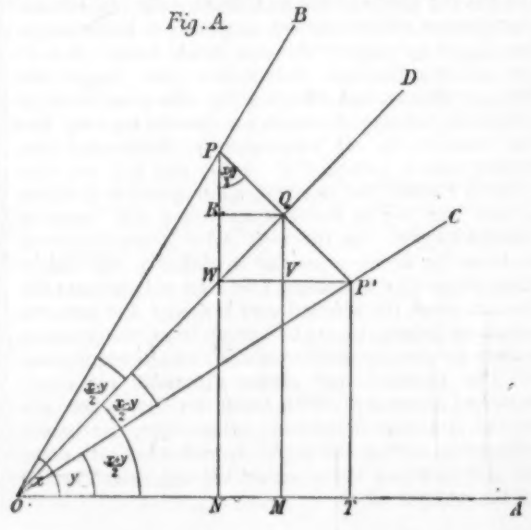
25. Apply Forms. B, H, and cancel.

CHAPTER IX.

REDUCING THE SUM AND DIFFERENCE OF TWO SINES OR COSINES TO FACTORS (*continued*).

133. We now proceed to give two geometrical proofs of the important formulæ proved in the last chapter.

Fig. A.



134. Let AOB and AOC contain x and y angular units respectively. Bisect angle COB by OD. Then BOD and COD contain $\frac{x-y}{2}$ angular units, and AOD contains $\frac{x+y}{2}$ such units.

In BO take any point P and from it draw perpendiculars PQ and PN to OD and OA. Produce PQ to meet OC in P′.

From Q and P′ draw perpendiculars QM and P′T to OA, and QR and P′W to PN. The latter cutting QM in V. Then the triangles OQP and OQP′ are equal in every respect and also the triangles PRQ and QVP′ ∴ PR = RW. As in par. 61, we must prove that angle QPR = angle QOM and ∴ contains $\frac{x+y}{2}$ angular units.

135. If the student have any difficulty in seeing that AOD contains $\frac{x+y}{2}$ angular units, let him draw the angle BOE = AOC (it is not drawn in the figure), ∴ AOE contains $x+y$ angular units, and since AOD is evidently the half of AOE it contains $\frac{x+y}{2}$ angular units.

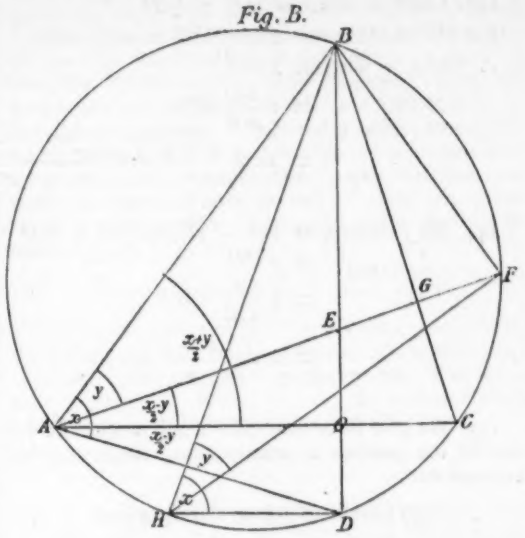
136. $$\text{Sin A} + \text{sin B} = \frac{\text{PN}}{\text{OP}} + \frac{\text{P'T}}{\text{OP'}}$$
$$= \frac{2\,\text{QM}}{\text{OP}} \text{ since OP'} = \text{OP}$$
$$= 2\,\frac{\text{QM}}{\text{QO}}\,\frac{\text{QO}}{\text{OP}}$$
$$= 2 \sin \frac{x+y}{2} \cos \frac{x-y}{2}$$

137. $$\text{Sin A} - \text{Sin B} = \frac{\text{PN}}{\text{OP}} - \frac{\text{P'T}}{\text{OP'}}$$
$$= \frac{\text{PW}}{\text{OP}} = \frac{2\text{PR}}{\text{OP}}$$
$$= 2\,\frac{\text{PQ}}{\text{OP}}\,\frac{\text{PR}}{\text{PQ}}$$
$$= 2 \sin \frac{x-y}{2} \cos \frac{x+y}{2}.$$

138. $$\text{Cos}\,x + \text{Cos}\,y = \frac{\text{ON}}{\text{OP}} + \frac{\text{OT}}{\text{OP'}}$$
$$= \frac{2\,\text{OM}}{\text{OP}}$$
$$= 2\,\frac{\text{OM}}{\text{OQ}}\,\frac{\text{OQ}}{\text{OP}}$$
$$= 2 \cos \frac{x+y}{2} \cos \frac{x-y}{2}.$$

139. $$\text{Cos}\,y - \cos x = \frac{\text{OT}}{\text{OP'}} - \frac{\text{ON}}{\text{OP}}$$
$$= \frac{\text{NT}}{\text{OP}} = \frac{2\,\text{NM}}{\text{OP}} = \frac{2\,\text{RQ}}{\text{OP}}$$
$$= 2\,\frac{\text{RQ}}{\text{PQ}}\,\frac{\text{PQ}}{\text{OP}}$$
$$= 2 \text{ Sin } \frac{x+y}{2} \sin \frac{x-y}{2}.$$

Fig. B.



140. We can also prove these Formulæ by means of the figures of par. 66.

Let AC and BD be two chords of a circle that cut one another in O at right angles. Let BO be greater than OD, and AO than OC. From OB cut off OE = OD. Join AE and produce it to meet circumference in F. Draw diameter BH, join other points as in figure. Triangles BGE and BGF can be proved equal in every respect.

Let BAD or BHD and BAF or BHF contain x and y angular units respectively. Then DAC or DBC or CAF contain $\frac{x-y}{2}$ angular units.

BAC = BAF + FAC

∴ BAC contains $y + \frac{x-y}{2}$ or $\frac{x+y}{2}$ angular units.

Remembering that, referred to the diameter, the chord opposite an angle at the circumference = the sine of that angle; we have:—

141. $$\text{Sin}\,x + \text{sin}\,y = \text{BD} + \text{BF} = \text{BD} + \text{BE}$$
$$= 2\,\text{BO}$$
$$= 2\,\frac{\text{BO}}{\text{BA}}\,\text{BA}$$
$$= 2 \sin \frac{x+y}{2} \cos \frac{x-y}{2}$$

Since $\text{AB} = \sin \text{ADO} = \sin\left(90° - \frac{x-y}{2}\right) = \cos \frac{x-y}{2}$

142. $$\text{Sin}\,x - \text{sin}\,y = \text{BD} - \text{BF} = \text{BD} - \text{BE}$$
$$= 2\,\text{DO}$$
$$= 2\,\frac{\text{DO}}{\text{AD}}\,\text{AD}$$
$$= 2 \sin \frac{x-y}{2} \cos \frac{x+y}{2}$$

Since $\text{AD} = \sin \text{ABO} = \sin\left(90° - \frac{x+y}{2}\right) = \cos \frac{x+y}{2}$

143. $\text{Cos } x + \cos y = \text{HD} + \text{HF}$

But HF = AC, since angle HBF = angle ABC

$$\therefore \text{Cos } x + \cos y = 2\,\text{AO}$$
$$= 2\,\frac{\text{AO}}{\text{AB}}\,\text{AB}$$
$$= 2\cos\frac{x+y}{2}\cos\frac{x-y}{2}$$

144. $\text{Sin } y - \sin x = \text{HF} - \text{HD} = \text{AC} - \text{HD}$
$$= 2\,\text{OC}$$
$$= 2\,\frac{\text{OC}}{\text{CB}}\,\text{CB}$$
$$= 2\sin\frac{x-y}{2}\sin\frac{x+y}{2}$$

145. We give three examples of elimination for the sake of the practice in manipulating trigonometrical expressions.

(i.) Eliminate θ from the equations

$\text{Sin } \theta = m\cos\phi + n\sin\phi$ ..... i.

$\text{Cos } \theta = m\sin\phi - n\cos\phi$ ..... ii.

Squaring i. $\text{Sin}^2\theta = m^2\cos^2\phi + 2mn\cos\phi\sin\phi + n^2\sin^2\phi$

„ ii. $\text{Cos}^2\theta = m^2\sin^2\phi - 2mn\cos\phi\sin\phi + n^2\sin^2\phi$

adding and applying Form. 1.

$$1 = m^2 + n^2$$

(ii.) Eliminate θ from the equations

$$\frac{x}{a\sin\theta} + \frac{y}{b\cos\theta} = 1. \qquad \text{i.}$$

$$\frac{x}{a\sin^2\theta} + \frac{y}{b\cos^2\theta} = 0. \qquad \text{ii.}$$

from ii. $bx(1-\sin^2\theta) + ay\sin^2\theta = 0$

$$(bx - ay)\sin^2\theta = bx$$

$$\therefore \text{Sin } \theta = \frac{\sqrt{bx}}{\sqrt{bx - ay}}$$

again from ii. $bx\cos^2\theta + ay(1-\cos^2\theta) = 0$

$$(ay - bx)\cos^2\theta = ay$$

$$\text{Cos } \theta = \frac{\sqrt{ay}}{\sqrt{ay - bx}}$$

Substituting in (i.)

we have $\dfrac{x\sqrt{bx-ay}}{a\sqrt{bx}} + \dfrac{y\sqrt{ay-bx}}{b\sqrt{ay}} = 1$

$$\therefore bx\sqrt{ay}\sqrt{bx-ay} + ay\sqrt{bx}\sqrt{ay-bx} = ab\sqrt{abxy}$$

or $\sqrt{bx}\sqrt{bx-ay} + \sqrt{ay}\sqrt{ay-bx} = ab.$

In these questions the result is often given in examinations, thus

If $a = \sec\theta + \text{cosec } \theta\tan^3\theta(\text{cosec}^2\theta + 1)$ i.

$b = \tan\theta - \tan^3\theta(\text{cosec}^2\theta + 1)$ ii.

prove $a^{\frac{2}{3}} - b^{\frac{2}{3}} = 2^{\frac{2}{3}}$

Were the result not given the problem would be; Eliminate θ from the above equations.

When the result is given, the method of solution is generally suggested by it.

from i. $a = \dfrac{1}{\cos\theta} + \dfrac{\sin^2\theta}{\cos^3\theta}(\cot^2\theta + 2)$

$$= \frac{1}{\cos\theta} + \frac{1}{\cos\theta} + \frac{2\sin^2\theta}{\cos^3\theta}$$
$$= \frac{2(\cos^2\theta + \sin^2\theta)}{\cos^3\theta}$$
$$= \frac{2}{\cos^3\theta}$$
$$\therefore a^{\frac{2}{3}} = \frac{2^{\frac{2}{3}}}{\cos^2\theta}$$

from (ii.) $b = \dfrac{\sin\theta}{\cos\theta} - \dfrac{\sin^3\theta}{\cos^3\theta}(\cot^2\theta + 2)$

$$= \frac{\sin\theta}{\cos\theta} - \frac{\sin\theta}{\cos\theta} - 2\frac{\sin^3\theta}{\cos^3\theta}$$
$$\therefore b^{\frac{2}{3}} = \frac{2^{\frac{2}{3}}\sin^3\theta}{\cos^2\theta}$$
$$a^{\frac{2}{3}} - b^{\frac{2}{3}} = \frac{2^{\frac{2}{3}}(1-\sin^2\theta)}{\cos^2\theta}$$
$$= 2^{\frac{2}{3}}$$

The student is advised to work every example of elimination that he can collect, as they require great practice to be able to prove with facility.

146. EXAMINATIONS AND EXAMPLES, IX.

Prove the following 5 identities.

1. $\text{Sin } y + \dfrac{\sin(2x-y) - \sin y}{1 + \cos 2x} = \tan x\cos y.$
2. $(\text{Cos } x - \sin x)(\cos 2x - \sin 2x) + \sin 3x = \cos x.$
3. $\text{Cos } 2x - \sin 2x\tan x = \cos 4x + \sin 4x\tan x.$
4. $\text{Tan } x + 2\sin^2 x\cot 2x = \sin 2x.$
5. $\dfrac{2\cos 2x}{\text{Cos } x + \sin x} + \dfrac{2\sin 2x}{\cos x - \sin x} = \dfrac{\sqrt{2}}{\cos(x + 45°)}.$
6. If $\dfrac{a}{\cos\alpha} = \dfrac{b}{\cos\beta} = \dfrac{c}{\cos\gamma}$ and $\alpha + \beta + \gamma = \dfrac{\pi}{2}$

   prove $\dfrac{a^2 + b^2 - c^2}{2ab} = \sin\gamma.$
7. If $2A + 2B + 2C = 180°$, prove—

   $\text{Sin } (2C + A) + \sin(2A + B) + \sin(2B + C) + 1 = 4\cos\dfrac{A-B}{2}\cos\dfrac{B-C}{2}\cos\dfrac{C-A}{2}$
8. If $A + B + C = 180°$

   prove $\cos C = \dfrac{\sin^2 A + \sin^2 B - \sin^2 C}{2\sin A\sin B}$
9. If $A + B + C = 90°$

   prove $\dfrac{\sin 2A + \sin 2B - \sin 2C}{\sin 2A + \sin 2B + \sin 2C} = \tan A\tan B.$
10. Prove $\sin 3\theta\sin^3\theta + \cos 3\theta\cos^3\theta = \cos^3 2\theta$
11. If $a = b\cos C + c\cos B$ i.

    $b = c\cos A + a\cos C$ ii.

    $c = a\cos B + b\cos A$ iii.

    prove $\cos C = \dfrac{a^2 + b^2 - c^2}{2ab}$
12. Prove $\tan(A + B + C) = \dfrac{\tan A + \tan B + \tan C - \tan A\tan B\tan C}{1 - \tan A\tan B - \tan B\tan C - \tan C\tan A}$
13. From 12 if $A + B + C = 180°$

    prove $\tan A + \tan B + \tan C = \tan A\tan B\tan C.$
14. If $A + B + C = 90°$

    prove $\dfrac{1 - \cos 2A + \cos 2B + \cos 2C}{1 - \cos 2C + \cos 2A + \cos 2B} = \dfrac{\tan A}{\tan C}$

15. If $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$

A, B, C, being the angles of a triangle prove $a \cos B + b \cos A = C$.

Solve the 5 following equations.

16. $\text{Sec } 3\theta + 3 \sec \theta - 4 \cos \theta = 0$.

17. $\text{Sin } 9x + \sin 5x + 2 \sin^2 x = 1$.

18. $\sqrt{2} - \sqrt{2}(\cos 2x - \cos x) + \frac{2}{\sec x} = 1$

19. $\left(\text{Sin } \frac{x}{2} \cos \frac{3x}{2} - \cos x\right) + \frac{1}{2} = 0$.

20. $2 \cos^2 x - \sin 2x - 2 \cos^2 x \cos 2x = 0$.

21. If $\tan \phi = \cos \theta \tan \alpha$ i.
$\tan \beta = \tan \theta \sin \phi$ ii.
prove $\cos^2 \alpha = \cos^2 \beta \cos^2 \phi$.

22. If $\frac{x}{a \sin \theta} + \frac{y}{b \cos \theta} = 1$ i.

and $\frac{x}{a \sin^3 \theta} + \frac{y}{b \sin^3 \theta} = 0$ ii.

prove $\frac{x^{\frac{2}{3}}}{a^{\frac{2}{3}}} + \frac{y^{\frac{2}{3}}}{b^{\frac{2}{3}}} = \frac{(ab)^{\frac{1}{3}}}{\sqrt{(bx)^{\frac{2}{3}} + (ay)^{\frac{2}{3}}}}$

23. Eliminate θ from the equations

$a \sec \theta + b \cot \theta = \sqrt{2 ab \operatorname{cosec} \theta}$ i.

$b \operatorname{cosec} \theta + a \tan \theta = \sqrt{2 ab \sec \theta}$ ii.

24. $\text{Cos } 2\theta = \frac{a \cos 2\phi - b}{a - b \cos 2\phi}$

prove $\tan \theta = \sqrt{\frac{a + b}{a - b}} \tan \phi$.

25. Eliminate α and β from equations

$\tan 2\alpha = m$

$\tan 2\beta = n$

$\tan \alpha \tan \beta = c$.

(To be continued.)

—o—

Lectures on Shakspere's 'King Lear.'

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No. VI. Act II., Sc. 4.

WE will begin with some passages which, though they contain very few difficult or unusual words are, nevertheless, a little obscure. Such passages are pretty numerous in Shakspere.

In line 23, Lear exclaims:—

> 'tis worse than murder
> *To do upon respect such violent outrage.'*

The difficulty here lies in the words *upon respect*. A student who should explain *respect* as being equivalent to 'a respectable person' (abstract for concrete) would have shown some acquaintance with the power of the English language. But in all probability these words constitute an adverbial phrase and mean 'upon consideration' or 'deliberately.' I have looked in vain for a note on the lines—

> 'Ere I was risen from the place that showed
> My duty kneeling' (28, 9).

Take the words literally and they are simply nonsense. Who ever heard of 'duty kneeling.' But though 'duty' cannot kneel, a dutiful man (*i.e.*, a man mindful of his duty) may, perhaps, do so. I am inclined therefore to consider *my duty kneeling* as meaning 'me kneeling in a dutiful manner.' The next passage requiring comment is *spite of intermission* (32). Probably this means the message which intervened, that is to say, the previous interruption on the part of Kent or the fact of Kent's having already claimed the attention of the duke. Why Shakspere used this rather obscure language to denote a very simple idea is hard to discover. The writer once discovered, when engaged in the examination of a large school, an opinion among certain of the pupils that Shakspere made his plays difficult in order to find occupation for schoolboys! Not very easy to understand are the lines—

> 'Mere fetches,
> 'The images of revolt and flying off' (84, 85).

Fetches means *excuses*, and *images* are *signs*. *Revolt and flying off* may be paraphrased by *rebellion* and *desertion*. The man who deserts another 'flies off' in the language of Shakspere, or, in ordinary prose, goes off and leaves him. Next, note the lines—

> 'Infirmity doth still neglect all office
> Whereto our health is bound.' (101, 102)

Again we look for a note in the Clarendon Press edition, and again we are unable to discover one. Certainly this passage seems harder than many of those of which an explanation is offered. *Infirmity*, we know, means *weakness*, but whose weakness is it? Lear's, or Cornwall's? and what, again, is meant by *office to which our health is bound?* May we suggest that the passage amounts merely to the general statement that sickness continually causes us to neglect all duties which it is for our welfare to perform? Lear has checked his rising indignation for a moment, telling himself that illness is a good excuse for the non-performance of one's duty. What, again, is the point of the apparently silly remark about the eels, and about the man who buttered his horse's hay? Probably the fool intimates that absurd cruelty and absurd kindness have pretty much the same origin. The use of the abstract for the concrete meets us once more in *led by some discretion* (144) where it seems perfectly certain that *discretion* means 'a discreet person.' A little further on *dotage* stands for a doting old man. *How this becomes the house* (148) seems to mean 'how becoming all this is to the household,' that is to say, how admirably this submission of the elder to the younger accords with the proper constitution of a household. Of course this is spoken ironically. In *Out of that provision* (201) the phrase 'to be out of' is the ordinary colloquial expression which means 'to be unprovided with,' as when a tradesman remarks that he is 'out of' this or that article which a customer may have asked for. By *those that mingle reason with your passion* (230), Regan means, in all probability, 'those persons that speak temperately to you when your language exceeds the bounds of moderation.' Note next the line (267):—

> *'You heavens give me that! patience, patience I need.'*

A moment's consideration will show that the line is too long. The simplest emendation is to leave out *that*, which will make the line just the right length. In *fool me not so much to bear it tamely* some words must be inserted before we can make sense of the passage. Perhaps by supplying *as to cause me* after *so much* we should fill up the ellipsis satisfactorily. *Well-bestowed* (285) means, we suppose, the same as 'comfortably lodged.'

Now and then Shakspere's language exhibits a slight variation of a well-known phrase, which wears in consequence an air of strangeness. Such instances are *make offence* (58), *take patience* (133), *hold amity* (238), and *put himself from rest* (286). The customary expressions are *give* offence, *have* patience, *maintain* friendship, while probably hath *put himself from* rest means that he has *deprived himself of* it. Here, perhaps, *rest* means *shelter*.

Two not very brilliant puns are perpetrated in the beginning of Scene 4. In *Cruel garters* there is a play upon *cruel* (the adjective), and *crewel* (*i.e.*, *worsted*), a material of which garters were often made. The witticism which mixes up *dolours* and *dollars* was considered so excellent by Shakspere that he actually introduced it into two of his plays. It turns up again in the Tempest (Act II., Sc. 1).

For the student who wishes to test his knowledge of the 4th Scene we here propose a few easy questions: Quote the equivalent in Shakspere's language of 'Explain to me;' 'a messenger in a perspiration;' 'more courage than discretion;' 'this removal (to Gloster's house) is only stratagem;' 'strike her unborn child ye infectious airs;' 'to struggle against;' 'to give heed to bad advice.'

Mention an instance in which Shakspere writes *followed with* instead of *followed by*, and point out another in which an abstract noun is used, contrary to custom, in the plural number, and passages in which the verbs *approve* and *allow* have the meaning of *confirm* and *approve* respectively.

The expression *to scant my sizes* means 'to cut short my allowance.' The old University term 'a sizar,' denoted, in days gone by, a student who received his 'sizes,' or 'sizings,' *i.e.*, his food, from the College, on condition of performing certain menial services which are now abolished. A 'sizarship' now means pretty much the same as a scholarship, but is of less pecuniary value.

In the passage—

> '*Where's he that hath so much thy place mistook*
> *To set thee here?*'

we must understand *as* before *to set*.

In *coming from us* (26) *as thou didst* must be understood after *coming*. Notice the absence of the *s* of the third person singular in *How chance the king, &c.* (60), and *What need you five and twenty?* (257). Before *return with her* (207), supply 'do you bid me?' With *let shame come when it will* (222), we must supply *to thee* after *will*. *For his particular* must mean *as regards himself*. Perhaps *self* is understood after particular.

The adverb *whiles* supplies us with an instance of adverbs which are formed from nouns by the addition of the *s* which is the characteristic of the possessive case. The word while (A.-S. *hwil*) is a noun meaning 'time.' Other genitival adverbs are *needs*, *once* (A.-S. *anes*), *twice* (A.-S. *twyes*), *unaware-s*, &c. The expression *your highness' letter* will afford the student a good opportunity of enunciating the rule with regard to the possessive case of nouns which end in *s*. Students preparing for an examination in which grammatical questions will be given along with others on the subject-matter of the play will do well to learn all about such expressions as *sith that*, *or ere*, and the like, and the etymology of *betwixt*. However, an explanation of the ordinary facts and rules of grammar are beyond the scope of these articles.

Act III., Sc. 1.

Line 6, *the main*	the mainland.
„ 12, *the cub-drawn bear*	the bear whose breasts have been sucked dry by its cubs.
„ 18, *upon the warrant of my note*	on the strength of my observation of you.
„ 19, *a dear thing*	an important matter.
„ 26, *snuffs and packings*	petty displeasures and intrigues.
„ 29, *furnishings*	outward signs.
„ 33, 34, *at point to show*	all ready to display.
„ 45, *my out-wall*	my exterior, my outward appearance.

The expression *his little world of man* is an allusion to an ancient notion that man was a *microcosm*, or little world, composed of elements corresponding to those of the external world.

Scene 2.

Line 24, 25, *speculations intelligent*	news-bearing watchers (once more we have the abstract for the concrete).
„ 4, *Thought-executing fires*	(1) Fires that do execution as swiftly as thought. (2) Fires that carry out the intentions of the gods.
„ 5, *vaunt couriers*	avaunt couriers, forerunners.
„ 43, 44, *man's nature cannot carry the affliction nor the fear*	man's nature cannot bear the shock of the tempest or the fear it occasions.
„ 49, *simular*	counterfeit.
„ 53, *your concealing continents*	that which conceals and contains you.
„ 53, 54, *cry those dreadful summoners grace*	ask pardon of those elements that summon you so dreadfully.
„ 60, *demanding after you*	enquiring for you, seeking for you.

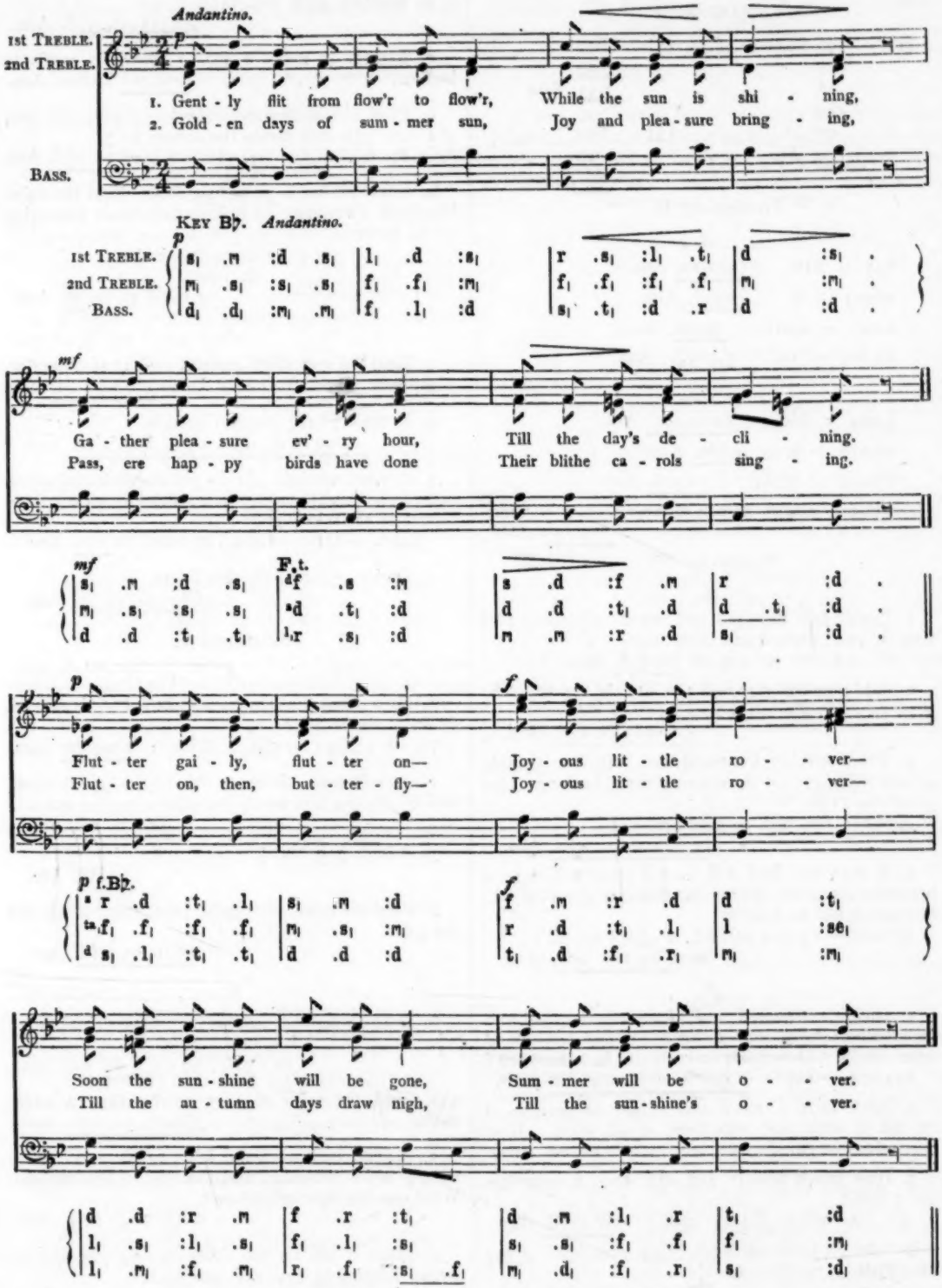
In this scene *spill* has the meaning of *kill or destroy*, *subscription* means *submission*, *gallow* means *frighten*, *simular* means *counterfeit*.

[In the last Lecture (page 224, line 30), the words 'for get rid of by being asleep,' should be substituted for 'for get rid of "being asleep."']

(To be continued.)

—o—

THE BUTTERFLY.


Andantino.
1st TREBLE.
2nd TREBLE.
BASS.
1. Gent - ly flit from flow'r to flow'r, While the sun is shi - ning,
2. Gold - en days of sum - mer sun, Joy and plea - sure bring - ing,
KEY B♭. Andantino.
Ga - ther plea - sure ev' - ry hour, Till the day's de - cli - ning.
Pass, ere hap - py birds have done Their blithe ca - rols sing - ing.
F.t.
Flut - ter gai - ly, flut - ter on— Joy - ous lit - tle ro - - ver—
Flut - ter on, then, but - ter - fly— Joy - ous lit - tle ro - - ver—
f.B♭.
Soon the sun - shine will be gone, Sum - mer will be o - - ver.
Till the au - tumn days draw nigh, Till the sun - shine's o - - ver.

Recent Inspection Questions.

Arithmetic.

STANDARD I.

(1) 196, 209, 68, 589, 97 — 1,159. Ans.

(2) 897, 243 — 654. Ans.

(3) 800, 19 — 781. Ans.

STANDARD II.

A.

897 × 816. 731,952. Ans.

18003 ÷ 8. 2,250$\frac{3}{8}$. Ans.

6,003 − 2,091. 3,912. Ans.

82,164 ÷ 11. 7,469$\frac{5}{11}$. Ans.

B.

7,029 × 860. 6,044,940. Ans.

23,040 ÷ 8. 2,880. Ans.

19,012 − 8,704. 10,308. Ans.

8,003 + 609 + 25,014 + 80,000 + 2 + 608. 114,236. Ans.

STANDARD III.

A.

1. Divide two hundred and twenty thousand and sixty by two hundred and thirty nine.

220,060 ÷ 239 = 920$\frac{80}{239}$. Ans.

2. Add together £75,096 17s. 4½d., £829 0s. 10d., £73 5s. 8¾d., £9 16s. 3d., £4,076 9s. 6d.

£80,085 9s. 8¼d. Ans.

3. From seventy thousand and forty-five pounds sixteen shillings and three-pence three farthings take £608 6s. 11½d.

£70,045 16s. 3¾d. − £608 6s. 11½d.

£69,437 9s. 4¼d. Ans.

4. A man who had a thousand pounds bought a house for £762 10s. 6d. and furniture for £176 9s. 8d., how much had he left?

£1,000 − (£762 10s. 6d. + £176 9s. 8d.)

= £60 19s. 10d. Ans.

B.

1. Divide a hundred and fifty-three thousand and seventy-five sheep into a hundred and forty-seven equal flocks. How many in each and how many left?

153,075 ÷ 147 1,041 flocks and 48 left. Ans.

2. John buys a score and a half of oranges at 1s. 0d. a score and sells them at 1d. each. How much does he gain? 1s. 0d. Ans.

3. How much less is 24s. 0¼d. than a sovereign and a half?

£1 10s. 0d. − £1 4s. 0¼d. 5s. 11¾d. Ans.

4. Add £73,024 9s. 6½d., £46 15s. 8½d., £395 12s. 7¼d., £39,146 10s. 8¼d.

£112,613 8s. 6½d. Ans.

STANDARD IV.

A.

1. Multiply £58 16s. 11¼d. by 91.

£5355 1s. 3¾d. Ans.

2. Reduce 3 miles 2 fur. 3 chains 2 yards to inches. 208,368 inches. Ans.

3. Find the difference between £5 8s. 6d. and £4 12s. 5½d. and divide the answer by 7.

(£5 8s. 6d. − £4 12s. 5½d.) ÷ 7 = 3s. 2½d. Ans.

4. Court plaster is 3s. per sq. foot. Find the value of a book containing 12 pieces, each piece measuring 12 sq. inches.

12 × 12 = 144 sq. inches

= 1 foot

1 ft. @ 3s. = 3s. Ans.

B.

1. Find the cost of 58 gross of pens at 3½d. per doz.

1 gross = 3s. 6d. 3s. 6d. × 58 = £10 3s. 0d. Ans.

2. Reduce 76,187 pints to bushels.

1,190 bush. 1 pk. 1 gal. 1 qt. 1 pt. Ans.

3. A man receives £1 to pay for 56 letters at 1d. each, and 16 at 2½d. each; how much change will there be out of the sovereign?

240d. − (56d. + 40d.) = 144d. = 12s. Ans.

4. Divide £4007 12s. 4½d. by 49.

£81 15s. 9$\frac{0}{4}$ $\frac{30}{49}$. Ans.

STANDARD V.

A.

1. How many lbs. can be bought for £9 12s. 1¾d. @ 8 lbs. for 7s. 8d.?

7s. 8d. : £9 12s. 1¾d. :: 8 lbs. : 200½ lbs. Ans.

2. A tradesman allows 2s. 8d. in the £ discount, find by practice how much that will be in £72 10s. 0d.?

£9 13s. 4d. Ans.

3. Add $\frac{5}{6}$, $\frac{3}{4}$, $\frac{1}{2}$, and $\frac{7}{8}$.

2$\frac{23}{24}$. Ans.

4. Find the value of 25 galls. 3 qts. 1 pint at 12s. 6d. per gall.

£16 3s. 5¼d. Ans.

B.

1. If 12 bottles cost 39s. find the value of 39 bottles.

bot. bot. s.

12 : 39 :: 39 : £6 6s. 9d. Ans.

2. Find the value of 4103 articles @ 11s. 11½d. each. £2453 5s. 0½d. Ans.

3. A gentleman died and left $\frac{2}{5}$ of his estate to his wife, $\frac{2}{5}$ to his daughter, and the rest to the steward. What was the steward's share?

1 − ($\frac{2}{5}$ + $\frac{2}{5}$) = $\frac{1}{5}$. Ans.

4. Make a bill for the following:—3 yrs. and 27 weeks' lodging @ 13s. 11d. per week.

£127 6s. 9d. Ans.

STANDARD VI.

A.

1. What is the interest on £450 for 73 days @ $2\frac{3}{4}$ per cent. per annum?

$$\frac{450 \times 2\frac{3}{4} \times 73}{365 \times 100} = \underline{£2\ 9s.\ 6d.}\ \text{Ans.}$$

2. Simplify $\frac{4\frac{1}{8} - 2\frac{1}{2}}{2\frac{1}{8}} \times 6\frac{16}{21} \div (3\frac{1}{2} - 2)$

$$1\tfrac{5}{8} \div 2\tfrac{1}{8} \times 6\tfrac{16}{21} \div 1\tfrac{1}{2}$$
$$\tfrac{13}{8} \times \tfrac{8}{17} \times \tfrac{142}{21} \times \tfrac{2}{3} = 3\tfrac{307}{1071}.\ \text{Ans.}$$

3. If a debtor pays 12s. 6d. in the £, how much will a creditor lose out of £423 10s. 0d.?

£1 − 12s. 6d. = 7s. 6d. the loss on £1.
£1 : £423½ :: 7s. 6d. : £158 16s. 3d. Ans.

4. I spent ·15 of my money and had 7s. 4d. left: how much had I at first?

1 − ·15 = ·85 fraction left
·85 : 1 :: 7s. 4d. : 8s. $7\frac{9}{17}$d. Ans.

B.

1. What is the amount of £575 for 3 years at 4 per cent. per annum?

$$\frac{575 \times 4 \times 3}{100} = £69 \text{ int.}$$
£575 + 69 = £644. Ans.

2. Reduce 3s. 6d. to the decimal of 4 guineas.

$$\frac{3s.\ 6d.}{4\ \text{guin.}} = \frac{3\frac{1}{2}}{84} = \frac{7}{168} = \underline{·041\dot{6}}.\ \text{Ans.}$$

3. A, B, and C buy a ship. A pays ·125 of the price, B ·625, and C £17,428 2s. 6d. Find the value of the ship and also what A and B paid.

1 − (·625 + ·125) = ·25 C's share
·25 : ·125 :: £17,428 2s. 6d. : £8,714 1s. 3d. A's
·25 : ·625 :: £17,428 2s. 6d. : £43,570 6s. 3d. B's
Whole ship = A + B + C's share
= £69,712 10s. Ans.

4. Simplify $\frac{3\frac{1}{2} - \frac{114}{36}}{2\frac{2}{3} \times \frac{1}{8}}$

$$(3\tfrac{1}{2} - 3\tfrac{1}{6}) \div (\tfrac{8}{3} \times \tfrac{1}{8}) = (\tfrac{1}{3} \div \tfrac{1}{3}) = \underline{1}.\ \text{Ans.}$$

STANDARD VII.

A.

1. In an army of 2,250 soldiers 16 % were killed and 26 % were wounded. Give the numbers who were killed, wounded, and unhurt?

100 : 2,250 :: 16 : 360 killed.
100 : 2,250 :: 26 : 585 wounded. } Ans.
2,250 − (360 + 585) = 1305 unhurt.

2. What is the discount on a bill for £546 5s. 0d., due three years hence, at 5 %?

£115 : £546¼ :: £100 : £475. Ans.

3. How long will it take £700 to produce £220 10s. at $4\frac{1}{2}$ per cent?

$4\frac{1}{2}$: 220½ :: 1 yr. : 7 yrs. Ans.
700 : 100

4. If one man walks 265 yards in 3 mins., another 308 yards, and another 351 yards, what is the average number of miles per hour?

(265 + 308 + 351) ÷ 3 = 308 yards in 3 mins.
308 × 20 = 6160 yards
= $3\frac{1}{2}$ miles per hour. Ans.

B.

1. In a dictation exercise, of the 36 boys in the class $\frac{1}{6}$ had no errors, $\frac{1}{4}$ had one each, $\frac{1}{9}$ had two each, and $\frac{1}{4}$ three each, the rest had 4 each, what was the average number of errors?

$\frac{1}{6}$ of 36 = 6, $\frac{1}{4}$ of 36 = 9

Errors			Errors
0	×	6	= 0
1	×	9	= 9
2	×	6	= 12
3	×	9	= 27
4	×	6	= 24
		36	) 72 (2 av. Ans.
			72

2. A man bought a gross of toys for 10s. and sold them for 1d. each. What was his gain per cent?

Gain on 10s. = 2s
10 : 100 :: 2 : 20 Ans.

3. In a school of 400 children 31 % are boys 41 % are girls, and the rest infants. Find the number of boys, girls and infants.

100 : 400 :: 31 : 124 boys.
100 : 400 :: 41 : 164 girls. } Ans.
400 − (124 + 164) = 112 infants.

4. The discount on a bill due in 10 months at 6 per cent. is £70: find the sum.

£100 @ 6% for 10 mos. = £5
Debt Debt
5 : 70 :: 105 : 1470 Ans.

Dictation and Composition.

STANDARD I.

A.

Book, small, coal, white, soap, table, Monday.

B.

Children, fellow, cheeks, noses, sheep, winter, covers.

STANDARD II.

One day the parrot was seated on her perch, basking in the rays of the sun, and looking about her. But a strong breeze was blowing up the river, and, as she turned round on her perch she lost her balance and was blown into the water.

STANDARD III.

Dick was now the master of this money, and with it he began business as a merchant in partnership with his late master. By his honesty and diligence, he won the favour of his partner, and the hand of his daughter. And strange to tell the thing came true that the bells had seemed to say to him when he was a poor lonely little boy.

STANDARD IV.

And here now is the other reason why we think comparatively little of it at first sight; its great breadth takes off so much from its height in appearance at any rate. Most persons have seen a cataract of some sort once in their lives. They recollect how the thin streak of water comes tumbling over the ledge and goes dashing down, leaping and flashing from rock to rock like some living and joyous creature.

STANDARDS V. AND VI.

Their growth and increase are all qualities which render them useful for a hundred different purposes, to serve which other materials would require much more labour and preparation. The bamboo is one of the most beautiful and most wonderful productions of the tropics, and one of nature's most valuable gifts to civilised man.

STANDARD V.

B.

A short story read about a cat, from Empire Reader, Standard II.

STANDARD VI.

B.

A letter to a friend while away on holidays.

Grammar.

STANDARD III.

A.

Answered questions: What is an adverb? A pronoun? Make sentence with adverb modifying a verb, modifying an adjective, modifying another adverb. Give pronoun in 1st person. In 2nd person. One referring to a girl in 3rd person. Pronoun in plural no. In sing. no.

B.

Pronouns and Abverbs from Dictation.

C.

Adjectives and Verbs from Dictation.

STANDARD IV.

Parse:—

A.

Parse these words carefully.

B.

On this slate your teacher puts sentences.

C.

I was a wayward girl.

STANDARD V. AND VI.

Parse and Analyse:—

A.

It hath lain upon a bosom where no other shroud shall lie.

B.

Surely some have 'scaped the Southron!
Surely some will come again!

—o—

Animal Physiology.

BY ARTHUR NEWSHOLME, M.D., AND C.S.S. (LOND.)

RESPIRATION *(continued)*.

Mechanism of Expiration

The expulsion of air from the lungs is under ordinary circumstances a comparatively passive process. The lungs themselves are extremely elastic and are constantly tending to assume a much smaller calibre than that of the period of inspiration. The thoracic walls are also somewhat elastic, and when the contraction of the intercostal and other respiratory muscles ceases they resume their original position and thus diminish the antero-posterior and lateral size of the thoracic cavity. The diaphragm which had become flatter and lower during inspiration, now resumes its original arched position, the return to this being aided by the liver and other abdominal organs (which had been pushed down in inspiration) rising to resume their former position.

In addition to the force exerted by the elastic resilience of the lungs and thoracic walls, certain muscles aid the expiratory effort, especially when it is voluntarily made more forceful than usual

The doubtful expiratory action of the hinder part of the internal intercostal muscles has been already mentioned. Some other small muscles attached to the ribs have an undoubted expiratory effect.

In laboured expiration the abdominal muscles are largely called into action. Being attached above to the ribs and costal cartilages and below to the pelvis, the effect of their contraction is to compress the abdominal viscera and thus force up the diaphragm; while at the same time they pull down the ribs and consequently diminish the antero-posterior and lateral diameters of the chest. The diaphragm and the inspiratory muscles of the neck and chest may voluntarily be made partially or entirely to counteract the expiratory effect of the abdominal muscles; and in this way the duration and the amount of the expulsion of air (and with it the production of voice), can be exactly regulated. The importance of this kind of action in oratory, singing, and performance on wind instruments is very great, and it is wonderful how delicately the amount and intensity of respiratory movements can be thus regulated.

Frequency of Respiratory Movements.

The respiratory acts are repeated in the adult about 17 times per minute. In children the number is considerably greater, diminishing as age advances. In sleep the respirations are only 13 or 14 per minute. Muscular exertion increases the frequency in the same proportion as it increases the cardiac beats. Even in standing the frequency is greater than when lying down.

During health there is in the great majority of cases one respiratory act to every four cardiac beats; thus the average respirations per minute in the adult being 17, the pulse will be 68. Any considerable alteration in the ratio between the pulse and respiration, except under the influence of emotion, is a valuable indication to the physician of disease. The duration of inspiration, as compared with that of expiration, is about as 10 to 12.

Quantity of air changed in respiration.

The following classification of the air occupying the lungs has been made. (1) *Tidal air* is that which is inspired and expired during ordinary respiration. (2) *Complemental air* is the excess over the ordinary breathing or tidal air, which can be introduced by a forcible inspiration. (3) *Reserve air* is that additional air to the amount expelled during an ordinary expiration, which can be expelled by a forcible expiration. (4) *Residual air* is the air remaining behind in the lungs even after a forcible expiration.

The amount of tidal air is variously stated as 20 to 30 cubic inches (30 cub. in. = 500 cubic centimetres) while the complemental, reserve, and residual air, probably, each of them, amount to about 100 cubic inches.

Extreme breathing capacity.

The extreme breathing capacity, or vital capacity as it has been called by Hutchinson, will evidently equal the sum of the tidal, the complemental, and the reserve air, *i.e.*, about 230 cubic inches; and this is what Hutchinson, as the result of an enormous number of observations, has found it to be in a man of medium height. It can be exactly measured by an appropriate instrument called a spirometer. Very curiously Hutchinson found that for every increase of one inch in height of the individual, between five and six feet, the vital capacity is increased eight cubic inches. This is remarkable, as it is well known that height depends more on the length of the legs than of the trunk.

Changes undergone by air in lungs.

The expired air differs in several important respects from the inspired. (1) Its *temperature* is raised. Thus, if the average temperature of the atmosphere be 20° C (68° F), that of expired air will be about 34° C (93° F).

(2) There is an increase of *aqueous vapour* in expired air. Probably about 25 ozs. of water escape from the lungs in the twenty-four hours, the amount being increased by exertion, or by increasing the fluids drunk.

(3) The expired air contains about 4 or 5 per cent. less oxygen and about 4 per cent. more *carbonic acid* than the inspired air, the nitrogen suffering little or no change. Thus:—

	Oxygen.	Nitrogen.	Carbonic Acid.
Inspired air contains	20·81	79·15	·04
Expired „ „	16·033	79·557	4·38

(4) Certain *organic impurities and ammonia* are added to the expired air. It is these organic matters which render respired air so injurious and cause the common 'stuffy' smell of inhabited rooms. Air containing as much as 1 per cent. of carbonic acid can be breathed without difficulty; but headache and giddiness are produced by breathing air containing 0·15 per cent. of carbonic acid, when this is derived from respiration and is therefore accompanied by organic impurities.

(5) Expired air is *less in volume* than that inspired, when both have been dried and measured at the same pressure, the difference amounting to $\frac{1}{40} - \frac{1}{50}$ of the volume of the inspired air. If all the oxygen absorbed by the lungs reappeared as carbonic acid, the volume of inspired and expired air would be identical; the difference is due to the fact that some of the oxygen has formed other combinations.

Exhalation of Carbonic Acid.

The elimination of carbonic acid requires to be considered in further detail. The student may be referred to the chapter on Metabolism, for a consideration of the chemical processes which result in the formation of carbonic acid. It will be remembered that the chief origin of carbonic acid is in the substance of muscles. In accordance with this fact it is found that *muscular exertion* at once and greatly increases the amount eliminated. In insects it has been found that sometimes a larger amount is eliminated in one hour of violent exertion than in twenty-four hours of repose. During *sleep* the amount eliminated is much diminished. According to Dr. E. Smith the quantity during the night is to the quantity during the day in complete repose as 10 is to 18. During hibernation a marmot was found to consume only $\frac{1}{30}$ of the oxygen which he used in his active condition, and to eliminate an even smaller quantity of carbonic acid.

Moisture and temperature have considerable influence. The exhalation of carbonic acid is much greater in a moist than in a dry atmosphere; and is much greater at low than at high temperatures. Dr. Smith finds that spring is the season of greatest elimination of carbonic acid, and autumn of least. The months of maximum elimination are January, February, March, and April; the months of minimum, July, August, and part of September; the months of decrease are June and July; of increase, October, November, and December.

Age and sex have some influence. Before birth animals are supplied with oxygenated blood from the mother, and respiration is unnecessary. During infancy the production of carbonic acid is probably greater in proportion to the weight of the body than in adult life. The observations of Andral and Gavarret show that there is an increase in the absolute amount of carbonic acid eliminated from the age of 12 to 32; a slight diminution from 32 to 60; and a considerable diminution from 60 to 82. Remembering the fact that the weight of the body usually increases with age, it is evident that the respiratory activity is much greater in youth than in adult life. As a rule women exhale less carbonic acid than men, which is partially accounted for by their smaller amount of exercise.

During *digestion* the exhalation of carbonic acid is greatly increased. Inanition gradually diminishes the exhalation of carbonic acid. During a fast of 27 hours Dr. Smith noticed that the exhalation of carbonic acid was diminished by one-fourth. The most constant effect of alcoholic drinks is to diminish the elimination of carbonic acid.

Amount of CO_2 eliminated

The average amount of carbonic acid eliminated by a healthy adult has been variously stated. Dr. Smith only found 0·4 cubic feet of carbonic acid to be eliminated per hour; Pettenkofer gives the amount as 0·7 c. feet per hour; Liebig as 0·79 c. feet and Dr. Parkes as 0·6 c. feet.

Accepting 0·6 cubic feet as the average amount of carbonic acid eliminated per hour, this is equivalent to 14·4 cubic feet per day; which reckoned as carbon equals 160 grains per hour, or half a pound of carbon in the twenty-four hours.

Problems of Ventilation

The above data are of great importance in determining the number of cubic feet of fresh air required to ventilate a room. External atmospheric air contains 4 parts of carbonic acid in 10,000 parts of air or ·04 per cent. The experiments of Drs. Parkes and De Chaumont have shown that when the carbonic acid reaches ·06 per cent. or 6 parts in 10,000, the air becomes perceptibly stuffy. This proportion may then be taken as the limit of impurity which should not be exceeded. The problem then in the ventilation of a room resolves itself into this:—to discover the amount of external air (containing ·04 per cent. of carbonic acid) that will be required to pass hourly through the room for every person in it, in order to keep the carbonic acid down to the ratio of ·06 per cent. As each person eliminates 0·6 cubic feet of carbonic acid per hour,—*i.e.* 3 × 0·2 c. ft., and the proportion of carbonic acid in the air must not be increased beyond 0·6 per 1000, or 0·2 per 1000 more than it is in the external air, it follows that the expired air must be diluted with 3 × 1000 or 3000 cubic feet of pure air per hour. This is the amount which is usually allowed per individual in the best ventilating arrangements.

(To be continued.)

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The Elements of Mental and Moral Science as applied to Teaching.

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[These articles are specially written to meet the requirements of candidates who are reading for the certificate examination.]

CONCEPTION, ABSTRACTION AND GENERALIZATION.

CONCEPTION is the power of forming general ideas. Conception is the process; and a concept is the result. A concept is a term general enough to include under it a number of other terms or individual objects in virtue of a certain number of qualities common to such terms or objects. Perception only deals with what is here and now, conception is not limited to a particular time or space, it is indeed a sort of generalized perception. We perceive this or that dog. We have a concept of dog in general. This concept is the result of two processes, abstraction and generalization. Abstraction is a process in which we direct our whole attention to one quality as it is found in different objects. Generalization is the process of grouping together a certain number of abstracted qualities so as to form a general idea or concept. There are two kinds of concepts: (1) Universal concepts like time, space, causality, which may be regarded as intuitive, and (2) general concepts which are formed only after a mental process. Without the former we cannot think at all, while the latter arise only as the result of thought.

To illustrate the working of conception take the general term 'insect.' This word, like all general terms, has two kinds of meaning. First it means a certain number of objects: fly, bluebottle, butterfly, cricket and a host of other animals. This is called the denotation or extension of a term. Secondly 'insect' means a certain combination of qualities invariably found in all the animals to which the term may be applied; fly, bluebottle, and the others. This is called the connotation or intension of a term. Educationally the connotation is the more important part of the term. It is more important to know what an insect is than to be able to name a great many insects, for, given the connotation, we can easily tell whether this or that animal is or is not an insect.

After examining a large number of animals we get the connotation of insect by abstracting a certain number of qualities and grouping them together. In this case the qualities are (1) having a ringed body (2) having the body divisible into three parts (3) having two antennæ and six legs. We may have examined hundreds of animals, and by abstraction may have obtained thousands of qualities, but generalization comes into play and selects only the three qualities mentioned. This group of three qualities gives us the concept insect. It is impossible to separate absolutely the connotation and the denotation of a term, but our process up till now has had regard mainly to connotation. Suppose now we examine a number of animals: a fly, a bee, a cricket, a bat, a wasp, a butterfly and a spider. We find that the fly, bee, cricket, wasp, butterfly possess the three qualities connoted by the term 'insect,' and therefore are entitled to that name, however unlike they may be to each other. The spider, however, though it is in ordinary language often called an insect, has no right to that name for it has eight legs. The bat is rejected because it has only four legs.

The connotation is never absolutely fixed, for all insects may have other qualities in common of which we know nothing, but for convenience there is usually chosen a fixed number of qualities which form the recognised connotation. The denotation on the other hand is always indefinite, for new individuals possessing all the qualities in question may be discovered at any time. Again the greater the connotation of a concept the less its denotation, and vice versâ. This is obviously true, for the greater the number of qualities grouped together the fewer the terms in which *all* those qualities are combined. Thus butterfly includes more qualities, that is, has a greater connotation than insect. But the term butterfly cannot be applied to so many animals as the term insect, that is, it has a more limited denotation. On the other hand the term animal implies fewer qualities, but includes more individuals than insect. Its denotation is greater while its connotation is less, as compared with insect.

A concept expressed in words is called a term. If the term is applied to an individual it is called a singular term, and corresponds to a proper noun in Grammar. By placing 'this' before a common term we make it a kind of singular term: as 'this butterfly.' A class term is a name applicable to a whole class. A class term is called a genus in relation to the term or terms comprised under it, and a species in relation to the higher class term which includes it. Thus insect is a genus to butterfly but a species to animal. The maximum genus is that genus which is never a species, which is never included under another term. The infima species is that term which includes no general terms under it but only individuals or singular terms. Thus taking the chain of terms:

Pure Being, Created-thing, Animal, Ringed-animal, Insect, Scaled-insect, Butterfly, Peacock-butterfly, the first 'Pure Being' is the maximum genus. There is no wider term to include it. Peacock-butterfly represents the infima species since it includes under it nothing but individual butterflies of that species. In the chain it will be observed that the denotation diminishes from the beginning to the end, while the connotation increases in the same direction.

The definition of a proper and of an abstract noun is often matter of serious difficulty with young teachers. In the light of what has gone before the following definitions may be intelligible as well as accurate. A proper noun is a term combining maximum connotation with minimum denotation. An abstract noun is a term combining maximum denotation with minimum connotation.

In Logic definition is simply genus plus difference. Thus we define man as a 'rational animal.' Animal is the genus of man; rational is the mark or difference which distinguishes man from all other animals. So an island is a 'small piece of land' (genus), 'wholly surrounded by water' (difference). In its more general acceptation definition is an expression which clearly marks off any term from every other term.

It is chiefly in connection with definition that the principles laid down in this chapter are applied to practical school work. It is clear that a definition is no more than the expression of the connotation of a term. Thus the definition of an insect is 'a ringed animal having its body divisible into three parts, of which the middle part bears six legs, and the front part two antennæ.' It therefore follows that a word which a child cannot define marks a concept which the child cannot grasp. Hence the enormous importance of definition in education. A writer who refers to the coral *insect*, and the child who tells his teacher that an insect is a 'beastie,' are on the same level of ignorance.

Definitions given to children are necessarily unsatisfactory in one of two ways. They are either *unintelligible* or *imperfect*. The latter alternative must be chosen. An abstract noun as defined above is more accurate but also less intelligible to a child than 'name of something you can neither see, taste, smell, hear nor touch.' The latter is imperfect and indeed erroneous, but an erroneous definition is better than one which is unintelligible. It is not true that a volcano is a burning mountain, but the statement is clear and will lead to truth. Huxley tells us that the next best thing to being clearly right is to be clearly wrong. Real danger lies in confusion. It may be objected that this principle is bad inasmuch as it leads the teacher to undo at one stage what he established at another. This is true, but it is the natural way of gaining knowledge and we have the highest authority for the educational value of provisional definitions. Most of Plato's dialogues consist in the discovery of a true definition by the successive overthrow of those which are false.

For the direct cultivation of the conceptive faculty object lessons are invaluable. By showing pictures of a dozen dogs, the teacher can make his pupils go through the actual process of abstracting their common qualities—their four leggedness, their hairiness, their tailedness, and so forth. Then these can be gathered together, and actually generalized into the concept dog. It will then be seen that in gaining this concept something has been lost. This general idea of dog can be applied to *any* dog, but it has bought this freedom at the expense of its colour, its size and other special qualities. In order to fit all dogs it must have no special size, colour, or shape. It sacrifices completeness for the sake of generality.

But the conceptive faculty is mainly cultivated in the ordinary school work, and especially in definition. Inspectors and others complain bitterly of the parrot-definition. Here objection is not taken to the definition which may be correct, but to its unintelligent use. 'Courage is bravery,' 'A plot is a conspiracy' are cases in point. Unless either the subject or the predicate of the definition gives the connotation, we have vain repetition. But even this is not enough. A child may glibly repeat our definition, and be no wiser. Here the evil lies in separating connotation and denotation. To bring these into relation copious illustration is necessary. We may try to bring the concept insect within the grasp of our pupil by giving the connotation and explaining each word we use. But the best and most natural way is to lay stress upon the denotation. This is the order most suited to the mind of the child, for in most cases they know the example before the rule, the concrete (*i.e.* qualities distinctly combined to form some definite *thing*) before the abstract. Ask an average sixth standard boy what a marsupial animal is, and the chances are that he will at once answer 'A kangaroo,' instead of giving the connotation 'a warm-blooded animal that carries its young in a pouch.' The pupils all know what a fly, a bluebottle, a butterfly is long before they know what an insect is. To explain our definition, therefore, it would be necessary to compare it with the description of each of these well known specimens.

There is no better way of cultivating clear conception than insisting upon clear, *however incomplete*, definition. 'So-and-so is'—ought to be the only accepted form of answer to the question 'what is so-and-so?' 'A pump is a thing for getting water out of the ground' is an infinitely better answer to the question 'what is a pump?' than:—'You get a boring instrument, and bore deep down, and then the water is allowed to rise' and so on. The latter may display much greater information, the former indicates a clearer concept however limited its connotation. By insisting on this form of answer, beginning at the lowest classes, the teacher will develop in the pupil the greatest clearness not only of expression, but of thought.

(To be continued.)

How to teach the Babies.

BY JAMES BAILEY.

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CHAPTER III.

THE TEACHER.

Upon no circumstance pertaining to the school and its work, is there a more general agreement than in the opinion as to the great influence of the teacher in moulding the character of the scholars, and in affecting the processes and results of a child's

education, and also as to the necessity there is that the teacher should be duly qualified and properly fitted for the work assigned. Opinions differ widely as to the best kind of buildings and fittings in which the work is to be carried on, as to systems of organization, and methods of instruction and of discipline, as to the subjects to be taught, even as to the sex of the teacher, the precise qualifications by which the teacher should be characterized, and the processes best adapted to secure those qualifications. But none dispute the proposition that, the most potent influence in school education is the teacher, or, that, it is his or her personality which more than anything else shapes the intelligence and mars or makes the progress of a child during its school-life. This is an influence felt strongly at all stages, but especially felt in the early years of the scholar's life. The extreme susceptibility of young children renders them peculiarly liable to impression from whatever surrounds them, and their natural leaning upon those who are older and stronger than they, emphasizes this tendency to rely upon their teacher, and to be greatly influenced by her. Of the Infant Department perhaps more than of any other is it true that 'the Teacher makes the School,' and the 'Babies' Class' of the Infant Department shews it more clearly than any other part of it.

The mingled helplessness and trustfulness of little children call strongly for corresponding qualities in their teacher, which are not altogether technical or professional, but which are more of the sort that give the mother and the father their hold upon the affections and the development of their charge. By these qualities alone can the sympathies of the children be evoked, their confidence secured, and that relation established with them which forms the only true and safe basis on which to found the superstructure of a true teacher's influence over them. For the kindly, genial, effective discipline by which very young children can be properly controlled and taught, this is absolutely essential. It is to the possession or the absence of such qualities in the teacher that we must look more than to any other cause for an explanation of the difference observable in the easy hold of the children, and the bright and happy development of their intelligence so characteristic of some infants' schools, and the strained, uncomfortable aspect, and cramped results to be noticed in others.

The most favourable conditions for the development of the life of a little child are the pleasant surroundings and genial influence of a good home, the joyous companionship of brothers and sisters, the tender sympathy and gentle nurture of the mother, the supporting guidance of a loving father. I know well that too many homes present a sadly different aspect from such as I here refer to, and I also know that school cannot be the exact counterpart of home, but it is nevertheless true, that the more nearly the arrangements of an Infant School, in respect particularly of its control and government, conform to those of a kindly and well ordered home, the more happily and successfully will the little ones be trained. And no mere system of organization, or methods and appliances of instruction and discipline, however well devised and skilfully carried out, can secure this apart from the personal living influence of the teacher.

It may be worth while to dwell for a little in passing, upon the wonderful effect producible upon the life and character of a child, by the circumstances which surround it, and act upon it from day to day during the progress from childhood to maturity. The great differences between the children in advancing years, of different races of men, or the lesser differences between the children of different classes of families of the same race are very obvious: differences of habit, of disposition, of behaviour, of speech. Differences of birth and origin, the hereditary transmission of inherited qualities, will doubtless account for some of these, but they are all due less to native differences than to the effect 'of the thousand nameless influences which surround every child, and which constitute the moral atmosphere in which he spends his youthful years.'

Jacob Abbott, in a most interesting chapter of his valuable little treatise 'The way to do good,' illustrates this in a characteristically-striking manner. He supposes a gathering of five hundred healthy infants, a few weeks old, taken from five very diverse sets of homes; one hundred from Constantinople, one hundred from the Highlands of Scotland, one hundred from the free-living pirates of the western seas, another hundred from the high nobility of aristocratic English families, and another hundred from the lowest and most degraded haunts of vice, say, in Paris. It would be scarcely practicable for even a minute, and thorough scrutiny to distinguish with great accuracy between the classes, and to assign to each its origin. The general appearances, the natural instincts, the cries of the children, would be the same. But let these be then sent back to their respective homes, and after the lapse of time has brought them to maturity again submit them to inspection. How great the differences now to be observed! What has caused this vast difference? Not so much the formal efforts of parents and friends to instruct and train these young children, as, 'in regard to almost all that relates to the formation of character, the sentiments and feelings,' to the many indirect influences of their surroundings, to a great degree unconsciously given and unconsciously received, and in very large measure from the *persons* among whom they have been brought up. Our author goes on to apply this to the consideration of the influence of the teacher's own personality and character and life upon the children committed to his charge. One great characteristic of young children is the ready catching of the spirit, and imitating the actions, of those about them, especially of those they love. It is certain that whoever takes an interest in a child, whoever by associating freely with him, and by sympathy and regard for him, secures his gratitude and love, will leave upon that child an impress of his or her own character and life which will never be removed. And thus it is that the teacher's words, temper, personal habits, modes of speech, and of dress, are unconsciously copied and assimilated so universally by the children.

It is this feature of child nature which gives such force to the consideration of the great influence wielded by the teacher, and to the necessity of the utmost care in the choice of a fitting person for the office. This is so obvious and so well understood that its recognition finds place in the views of every observant and thoughtful writer on the subject of school management and instruction. Amid the diversity of plans and suggestions recorded in the treatises alike of ancient and of modern educationists, there is an all but universally common agreement on the one point of the teacher's influence, and the need there is of

careful choice as to personal qualification and fitness. From the time of the great and wise Roman teacher, Quintilian, in the first century, who speaks of the especial necessity of careful choice of the teacher, as to knowledge, mental power, equable temper, and moral character, and emphatically of the need of the ablest and most suitable teacher for the very young, down through the schools of the Latin Fathers, the schoolmen of the Middle Ages, the times just prior to the Reformation, when Erasmus places amongst the first essentials of good training the important choice of an enlightened teacher, to Roger Ascham in the 'Scholemaster;' Comenius in the seventeenth century, who urged that the teacher must be cheerful and kind; Milton, who speaks of 'the spirit of the teacher working in the heart of the pupil; and John Locke, not to speak of Rabelais and Montaigne, it is ever the choice of the teacher, on which stress is laid, because 'it is the good tutor who defines the whole manner of your education.'

More recent educationists insist with not less emphasis, upon the same point. The effective and admirable system of training set forth by David Stow, is avowedly based to a great extent upon the commanding influence upon the child of the intellectual and moral habits and physical qualifications and general personal character of the teacher. There may be question as to whether the detailed methods of work in the school were not too much limited to the direct personal action of the teacher, by Mr. Stow's strong views on this point, and whether more was not expected from it, than could be successfully realized by the average teacher, but experience and observation shew that the principle acted on is right.

To quote further in this direction would be to give extracts from every good book on School Management and work. Again and again it is urged in varied terms that 'the ground principle of moral training is sympathy with right, as manifested by those on whom we depend, and to whom we are bound by the ties of love.' 'This which is the very foundation of the parent's power over the child must also be that of the teacher over the scholar.' 'Thus we have come to this ultimate fact in moral education, that it is the teacher's character which determines the character of the school; not what he does, so much as what he is.' 'There is probably no single position in the whole science of education that deserves to be commended to the teacher's daily reflection more than the organic connexion which exists between the means he has to work with and his own personal character.'*

The influence of the teacher's manner, tone of voice, look, words, temper, and whole bearing, as habitually, not fitfully, exercised are the conditions of impressiveness. No teaching about kindliness, self-control, gentleness, considerateness, good temper, neatness, truthfulness, can be effective, if patience, forbearance, evenness and goodness of disposition, tidiness and cheerfulness be wanting in the teacher herself; or if exaggeration, or breaking of promises, be shewn by her.

We thus get light on the requirements in the teacher, by noticing not only the material on which she works but the work itself she has to do. Complaint is still made in recent reports of H.M. Inspectors, notwithstanding the wide diffusion of knowledge of these matters, that the requisite qualifications are not so common as they should be. There are still Infants' Schools, in which the discipline is harsh and forced, in which the want of habitual brightness and winsomeness in the teacher's face, is reflected by a bleak and wintry aspect upon the faces of the little ones, in which the hard mechanical processes of teaching, supposed to be necessary with older scholars, usurp the freer, easier, and pleasanter methods proper to the instruction of the very young. But it is not unreasonable to hope that such schools are the exception, and that they are steadily diminishing.

We may now briefly sum up the personal elements requisite for successful infant teaching. There must certainly be to begin with, a love of little children, some knowledge of their ways and needs, and a quick sympathy with them. 'An even temper, a gentle sympathetic voice, a kindly and cheerful mien,' are also essential. As the power to interest the children is a first requisite of success, there must be a ready command of fluent, simple, speech; animation of manner, dependent upon some enthusiasm in the work of teaching; tact in management; and generally a bright and lively way of handling a class. Eye, voice, and hand must co-operate in this good work. Habitual cheerfulness must be joined with due decorum of manner. A patient, equable, disposition must go hand in hand with a calm, firm, yet genial assertion of authority. The teacher must ever *rule*, but it must be by love. And all this kept in even balance, by constant self possession. If it be too much to expect the complete possession of all these qualities in perfect combination, it is happily by no means rare to find a sufficient exemplification of them among the Infants' Teachers in the Public Elementary Schools of England. Of the highest qualifications I have said nothing, yet none but a Christian lady can stand as the highest type of teacher.

I finish this topic in the words of Samuel Taylor Coleridge, words whose beauty and force should be familiar to every teacher:—

O'er wayward childhood would'st thou hold firm rule,
And sun thyself in light of happy faces;
Love, Hope, and Patience, these must be thy graces,
And, in thine own heart let them first have school.
For as old Atlas on his broad neck places
Heaven's starry globe, and there sustains it, so
So do these uphold the little world below
Of Education—Patience, Love, and Hope.

. . . . . .

O! part them never! If Hope prostrate lie,
Love, too, will sink and die.
But Love is subtle and doth proof derive,
From her own life, that Hope is yet alive,
And bending o'er with soul-transfusing eyes,
And the soft murmurs of the mother dove,
Woos back the fleeting spirit and half supplies:
Thus Love repays to Hope what Hope first gave to Love,
Yet haply there may come a weary day,
When overtasked, at length
Both Love and Hope beneath the load give way;
Then with a statue's smile, a statue's strength,
Stands the mute sister, Patience, nothing loath,
And both supporting, does the work of both.

(To be continued.)

* Currie's 'Common School Education,' Chapter 'Conditions of Moral Education.'

There is also an excellent chapter on 'The Teacher,' in Morrison's School Management.

Thrift and the Post Office.

THE subject of Thrift has occupied more attention during the past twenty years than at any previous period of our country's history. The increase of our population, the keen competition of foreign countries for the trade of the world, and the spread of education, are some of the factors which have brought about this result. The National Thrift Society, by their publications, and the encouragement given to the establishment of Savings' Banks in schools by the Education Department, and the facilities offered by the Post Office for the saving of small sums of money, have also contributed towards the accomplishment of this object.

Early in the history of the National Union of Elementary Teachers, desires were expressed for the embodiment of provisions for sick pay and other benefits among the objects of the Union, and the result was the establishment of the Teachers' Provident Society. The great value of such a society has not been so widely or thoroughly appreciated as it deserves to be, but the report presented at the last general meeting was, nevertheless, of a very encouraging character. At the late conference of the Union at Bradford an attempt was again made to make compulsory the payment for benefits in old age and sickness, but one whose acquaintance with benefit societies was very extensive, completely upset the calculations of the proposer of the resolution by naming the payments which would be required for the purpose of securing all that was asked. The fact is, it is impossible, without Government help, to obtain either annuities or other benefits, without first paying for them. During Whit-week the annual meetings of the great benefit societies were held, and many of our readers will, no doubt, have been surprised at the vast numbers of enrolled members belonging to these bodies. In view of the fact, however, that there is still ample room for a further development of these principles, and with a desire to encourage habits of thrift among all classes of Her Majesty's subjects, the Postmaster-General has issued a leaflet, again calling attention to the facilities afforded by one branch of his department for providing against early death, and for making provision for old age and times of infirmity.

To this leaflet, and the exhaustive tables and information which may be obtained, free of charge, from any postmaster, or from the Comptroller of the Savings' Bank Department, General Post Office, London, we would direct the special attention of our readers, and more particularly those of them whose means are limited. At the same time, managers of schools would do well to consider whether they could not employ this method of assisting in providing for their aged teachers when they become unfit for the arduous duties of school life, after having given the best part of that life to their service.

The leaflet in question deals with two subjects—life insurance, and annuities. 'Insurances may be effected for any sum from £5 to £100, and annuities may be purchased, immediate or deferred, for any amount from £1 to £100.' Those whose lives are insured or to whom annuities are granted have direct Government security for the payment of the insurance or annuity money at the proper time. And no matter what a person's residence may be, he can transact any business of this character at every or any Post Office Savings' Bank throughout the kingdom, these offices being found in every town, and in most villages in Britain. No matter how small a teacher's salary may be, if so minded he can insure his life or provide an annuity for his old age from that salary, provided he commences soon enough. The great secret of ability to do this consists in taking care of the pence. The Postmaster-General has provided for this by the issue of the penny postage stamp slips, by means of which a shilling can be accumulated a penny at a time. So long as there are 18,000 teachers in this country whose salaries are less than thirty shillings a week, the saving of even a penny is an act of forethought and care.

An account may be opened at a Post Office Savings' Bank for any sum from a shilling upwards, and payments may be made to that account. The depositor who insures will have no difficulty respecting the premiums for his insurance, or for his annuity, for the officers will deduct the premiums from the banking account, and an intimation will be made to him which will serve as a receipt for the money. A male or female of twenty-one years of age may for a penny a week ensure the sum of £10 at death, or at the age of 60 for four pence a year more. Even so small a sum as £10 would be found of benefit in the case of an early death, and as the poorest teachers could spare more than a penny a week, there is no difficulty in calculating how much could be insured according to the means of saving. The teachers of the country have made great progress in their charitable donations. It speaks well for the profession that during the past year more than £12,000 has been raised by them for the benefit of their afflicted and aged brethren, and their orphaned or fatherless children. There will always be ample room for charity, but the practice of thrift would leave the charitable more money at their disposal for the help of those who unavoidably needed their assistance.

In addition or in preference to life insurance, provision may be made for old age by those who have no relatives dependent upon them. Annuities of any amount, from £1 to £100, may be purchased. These annuities are of two kinds, immediate and deferred. To obtain an immediate annuity a sum of money must be paid at the time of purchase. For a deferred annuity to commence on the attainment of a certain age, it can be paid either in one sum or by instalments. Deferred annuities can be purchased either under the Money Returnable or the Money not Returnable System. The premiums are higher under the former, but in the event of inability to continue paying the premiums or of death before the commencement of the annuity, the whole of the premiums are returned.

We cordially and earnestly recommend all our readers who have not already made provision for the future, who may be unwilling to join existing friendly societies for any reason, who may have only small amounts to save, and who may wish to make the best use of these small savings with the least trouble to themselves, to procure at any post office the leaflet and tables of payments, and to avail themselves of the advantages they offer.

How to Earn the 'Excellent' Grant.

By One of Her Majesty's Inspectors of Schools.

ELEMENTARY SCIENCE.

SIR JOHN LUBBOCK and his friends in Parliament certainly deserve well of the country. But for their efforts we should have been still witnessing the anomaly of a country depending for its very existence upon the maintenance of its position in the field of commercial science, content to leave that science practically untouched in its elementary schools.

No doubt science teaching did form part of the specific subjects of the Code, but comparatively few schools availed themselves of this teaching, and even now there are complete districts in which teachers do not avail themselves of the privilege of teaching Elementary Science as one of the class subjects.

The causes of this are not far to seek. The teachers themselves may not have had the instruction necessary to qualify them for imparting this very elementary knowledge of science. And, again, the rules by which, if only one class subject is taken, it must be English,—if two are taken, one of the two must be English,—if three are taken, one must be English and another drawing,—are distinctly adverse to science teaching. If the teachers were polled to-morrow we believe a very large majority of them would take geography in preference to English as the first class subject, were that liberty accorded them according to their votes, and would elect science as the second class subject.

But as matters stand—English being practically compulsory, though geography is first favourite—science has no chance, except where a great educational authority, like the London School Board, decides to adopt it as its second class subject.

The study of science may therefore be said to receive distinct discouragement. How should this be obviated? In the first place, by making Elementary Science a compulsory part of a pupil teacher's course, and thus making it incumbent upon teachers having the charge of pupil teachers to make themselves masters of sufficient Elementary Science to teach that subject with intelligence in their schools. In the second place, it will be necessary to give science an equally favoured position with English, under Art. 109 (f), (v) of the Code.

Granted, however, that science is taught under all the existing drawbacks, how can it be made an interesting and effective subject of instruction, and thus exert an excellent interest upon the Merit Grant? And to what branches of science may especial attention be paid with that object directly in view?

Experience has taught us that even in country schools the children are most strangely ignorant of the difference between one bird, one flower, one leaf, one grain, and another.

An English child should surely be able to distinguish between an elm and an oak leaf, the song of the thrush and a blackbird, the appearance of a frog and a toad, or of an edible and a poisonous mushroom?

Yet this is information that children who can parse and analyse a complex sentence, and string you off the exports of British Honduras and the minerals of the Oural Mountains, could not for the life of them afford you.

And how are they to discover differences without seeking for that which differentiates a sight, a sound, a substance? The senses of sight and hearing, nay all the senses, must be pressed into the service. This variety has a special charm for childhood. The restless activity of the child which Froebel was the first to employ scientifically in his Kinder-Garten, should be turned into useful channels. Let the children be taken for a walk by the teacher, over ground that is a good haunt for flowers and trees and plants of a familiar kind. Let him gather a spray of mountain ash for example, point out how its foliage differs from the common ash, describe its berries and their properties and, after some such chat, pocket the rowan spray and call on his young field naturalists for a fresh sprig from another tree. There will be an exciting hunt and, of course, in their hurry, some of the children will bring the wrong leaves and be sent back for the right ones. Or if the teacher be a bird-fancier, is it not better that his scholars should begin their ornithological studies *de ovo* with him, than indulge in bird-nesting at their own wild wills?

We know a School Board in Yorkshire which most wisely encourages the study of natural history in precisely this way in the case of the elder scholars. They are bound by a set of humane rules in their dealings with animals. They are instructed to be very sparing and discreet in taking birds' eggs. They are taught to observe birds and animals, but never to stone or ill-treat them upon their country rambles. They thus acquire, by wise direction, that true love for nature and that finer knowledge of natural history which is, as a rule, confined only to the self-instructed enthusiast, and an intelligent as well as humane opinion is being created, which will make cruelty to animals rarer and rarer in their neighbourhood. In the United States the system has obtained a wide development in associations of children, called 'Bands of Mercy.' Our Humane Society would do well to encourage a similar child co-operation in this country.

Butterflies and moths may fairly be included in those collections of natural objects which school children may thus be encouraged to collect. Instead of the crushing cap, the light butterfly net should be brought into use, and the insect bottled and asphyxiated with painless entomological skill. We know a school whose teacher has not only made his scholars familiar with the rarer, as well as the commoner English butterflies and moths, but actually makes his fifty or sixty pounds a-year by supplying London dealers with specimens caught by his scholars—of course, out of school hours.

Look at Schedule I. of the Code! Under Standards I., II. and III., we read: 'Common objects, such as familiar animals, plants, and substances employed in ordinary life.' The scheme of instruction for them and the higher standards, is left 'to the managers'—which means to the teacher, in nine cases out of ten.

It must have the approval of H.M. Inspector, and should be a progressive scheme, providing for not less than three groups. We should be inclined to say, from our general experience, providing for not less than three groups in town, and for more than three in country schools, as a rule.

It is obvious that Standards I. and II. should be taught together in small schools, and that Standards III. and IV., and Standards V.—VII. should also be taken together.

The courses of instruction suggested for Standards V.—VII. are pretty definite, and it is clearly anticipated that some course will be selected for the lower standards of a kind naturally leading up to them whenever they are taken up.

But there is nothing to prevent a teacher proposing to H.M. Inspector a totally distinct scheme of science from that indicated in the Code, provided that it proved to be in consonance with the capabilities of elementary scholars, as well as suitable to their surroundings.

The headings (a), (b) and (c), for Standards IV.—VII., are evidently designed, as far as possible, to meet local requirements.

E.G. 'Animals or plants, with particular reference to Agriculture,' is a course specially suited for a school in a rural neighbourhood.

In France, no school in the agricultural centres is, we are assured, without a stuffed or preserved collection of the farmer's friends and the farmer's enemies. Thus the thrush would be labelled 'friendly,' the blackbird and bullfinch 'dangerous;' the shrew would be classed as an enemy, the toad as a friend; the ladybird would be held up for praise, the red spider would be anathematized.

If animals in their relation to agriculture is the subject chosen, undoubtedly some such practical collection should be provided for the school, and the children should be encouraged to catch and bring to school for exhibition and comparison, the insects that are the blessing or the bane of the agriculturalist.

Injurious weeds should, in the same way, be discriminated from harmless ones, and directions given for their destruction.

Such specimen sheets as Oliver & Boyd's admirably exemplify 'the substances employed in arts and manufactures.' The children can also be invited to bring specimens of these substances, as far as they are employed in local manufactures.

It is well also for the teacher to take his scholars to visit any local industry that may exist. This will give children a much clearer conception of the arts and manufactures than any amount of theoretical teaching could do.

'The simpler kinds of physical and mechanical appliances' cannot be effectually explained by mere diagrams. The actual thermometer, barometer, lever, pulley, wheel and axle, and spirit level, should be exhibited and explained and set to work in the school. Better still, where the teacher can actually manufacture his own physical and mechanical appliances before his class, as we have known one master do whilst giving his parchment lesson before H.M. Inspector.

Mr. Fitch very justly states the reasons for the claims of science to be three in number:—

(1.) The utilities of physical truths; *e.g.*, every new and valuable invention, from the spinning-jenny to the telephone, is the product of scientific knowledge.

(2.) The beauty and intellectual attractiveness of the laws which govern natural phenomena.

For, as Professor Dowden writes: 'To enjoy the beauty of a landscape it is not necessary to understand the nature and arrangement of the rocks which underlie or rise up from the soil. . . . Nevertheless, a larger mass of pleasure is, in the end, possessed by one who adds to his instinctive, spontaneous feeling of delight, a knowledge of the geology of the country. . . . The lines of force in a landscape to which an ordinary observer is entirely insensible, come out to the instructed eye and give it thrills of strong emotion. The lines of force are drawn in the granite and the sandstone differently, and hence an endless variety of delights, corresponding to the infinite variety of the disposition of its rock forces by Nature.'

(3.) The disciplinal value of the inductive process.

'The observer must put his facts together, must group them according to their resemblances and differences, and see what they have to say for themselves. He must have no prepossessions, no wish to twist the facts into a particular direction. His theory or final generalization, when it comes, must have been actually suggested by facts.'

A teacher who bears these three objects in view, and more especially the last of the three, cannot fail to make his lessons in science vivid, humanizing, and, above all, vital in the formation of character.

—o—

MODEL ANSWERS TO

Pupil Teacher Examination Papers.

26th June, 1886.

CANDIDATES.

FIRST PAPER.

(Two hours and a half allowed for this paper.)

Dictation.

Write from dictation, in a neat hand, with correct spelling and punctuation, the passage read by the Inspector.

Arithmetic.

MALES.

1. Find *by Practice*, the cost of 1 ton 13 cwts. 1 qr. 23 lbs. 8 oz. at £5 16s. 8d. per cwt.

	£	s.	d.		
1 qr. = ¼ of 1 cwt.	5	16	8	= cost of 1 cwt.	
			33		
	192	10	0	= ,,	33 cwts.
14 lbs. = ½ of 1 qr.	1	9	2	= ,,	1 qr.
7 lbs. = ½ of 14 lbs.	0	14	7	= ,,	14 lbs.
2 lbs. = ¼ of 14 lbs.	0	7	3½	= ,,	7 lbs.
8 ozs. = ¼ of 2 lbs.	0	1	0½	= ,,	2 lbs.
	0	0	3½	= ,,	8 oz.
	195	12	4½	= cost of 1 ton 13 cwts. 1 qr. 23 lbs. 8 oz.	Ans.

2. What is the tax on a house rented at £327 12s. 6d. if the tax on a house rented at 35 guineas is £6 8s. 7½d.

£ s. : £ s. d. :: £ s. d. : tax required

36 15 : 327 12 6 :: 6 8 7½ :

or or or

8,820d. 78,630d. 6,174 far.

$$\frac{6174 \text{ far.} \times 78{,}630}{8{,}820} = 55{,}041 \text{ far.} = £57\ 6s.\ 8\tfrac{1}{4}d.\ \text{Ans.}$$

3. If 7 oxen can eat 3 tons of hay in a month, how long would it take 49 sheep to eat 35 tons,—an ox consuming three times as much as a sheep?

49 sheep : 7 oxen or 21 sheep
3 tons : 35 tons
} :: 1 mon. : time required

$$\frac{1 \text{ mon.} \times 21 \times 35}{49 \times 3} = 5 \text{ months. Ans.}$$

FEMALES.

1. Make out a bill for—

$3\frac{3}{4}$ lbs. tea at 2s. 6d. per lb.
5 stones salt at 4s. 8d. per cwt.
25 lbs. butter at 1s. $2\frac{3}{4}$d. per lb.
7 bars soap, each $11\frac{1}{2}$ lbs., at $2\frac{1}{4}$d. per lb.

Glasgow, June 26th, 1886.

Mr. Wm. Scott,

Bought of John Ireland.

$3\frac{3}{4}$ lbs. tea at 2s. 6d. per lb.	0	9	$4\frac{1}{2}$
5 stones salt at 4s. 8d. per cwt.	0	2	11
25 lbs. butter at 1s. $2\frac{3}{4}$d. per lb. ...	1	10	$8\frac{3}{4}$
7 bars soap, each $11\frac{1}{2}$ lbs., at $2\frac{1}{4}$d. per lb....	0	16	$9\frac{1}{4}$
	£2	19	$9\frac{1}{4}$

2. Find *by Practice*, the cost of 529 articles at £3 11s. 10d. each.

	£	s.	d.	
10s. = $\frac{1}{2}$ of £1	529	0	0	= value at £1 each.
		3		
	1587	0	0	= ,, ,, £3 each.
1s. 8d. = $\frac{1}{6}$ of 10s.	264	10	0	= ,, ,, 10s. each.
2d. = $\frac{1}{12}$ of 1s. 8d.	44	1	8	= ,, ,, 1s. 8d. each.
	4	8	2	= ,, ,, 2d. each.
	£1899	19	10	= ,, ,, £3 11s. 10d. each Ans.

3. Find *by Practice*, the cost of 49 acres 3 roods 5 poles at £2 5s. per acre.

	£	s.	d.	
2 roods = $\frac{1}{2}$ of 1 acre	2	5	0	= cost of 1 acre
		49		
	110	5	0	= ,, 49 acres
1 rood = $\frac{1}{2}$ of 2 roods	1	2	6	= ,, 2 roods
5 poles = $\frac{1}{8}$ of 1 rood		11	3	= ,, 1 rood
		1	$4\frac{1}{8}$	= ,, 5 poles
	£112	0	$1\frac{1}{2}$	= cost of 49a. 3r. 5p. Ans.

Grammar.

The hand of man *had* never yet *defaced* or deformed any part of this *native* scene, which *lay bathed* in the sunlight, a glorious *picture* of affluent forest grandeur, softened by the balminess of June, and relieved by the beautiful *variety afforded* by the presence of so broad an expanse of water.

1. Parse fully the words in italics in the above passage.

2. Classify the adjectives.

3. Explain the terms *intransitive, substantive, passive, auxiliary*, as applied to verbs.

(1.) Parsing :—

Had—aux. verb, past indic.
defaced—past. part.
had defaced—reg. trans. verb, indic., pluperf., 3rd pers., sing., agreeing with 'hand.'
native—adj., distinguishing 'scene.'
lay—irreg. intrans., *lie, lay, lain*, indic., past., indef., 3rd pers. sing., agr. with 'which.'
bathed—past part. of reg. verb *bathe*, qual. 'which.'
picture—com. noun, neut., sing., nom., in apposition with 'which' or nom. after 'lay.'
variety—abst. noun, neu., sing., obj., gov. by 'by.'
afforded—past part. of the reg. verb 'afford,' attributive to 'variety.'

(2.)

Adjective	Kind	Adjective	Kind
any	indefinite	affluent	qualifying
this	distinguishing	forest	distinguishing
native	,,	beautiful	qualifying
glorious	qualifying	broad	,,

(3.) *Intransitive* means that the action implied in the verb does not pass over to an object; as, 'I stand.'

Substantive means that the verb denotes existence, as 'I am.'

Passive means that the subject is affected by the action as, 'the boy was struck.'

Auxiliary means helping to form tenses as 'have,' mood as 'may,' 'can,' and voice as 'be.'

SECOND PAPER.

(One hour and a half allowed for this paper.)

Geography.

1. Mention the counties on the south coast of England, and name two towns in each.

Counties.	*Towns.*
Kent ;	Maidstone, Dover.
Sussex ;	Chichester, Lewes.
Hampshire ;	Southampton, Portsmouth.
Dorset ;	Dorchester, Poole.
Devon ;	Exeter, Plymouth.
Cornwall ;	Bodmin, Penzance.

2. Mention the rivers flowing into the German Ocean between the Moray Firth and the Wash.

The following are the principal rivers, Spey, Findhorn, Deveron, Don, Dee, Tay, Forth, Tweed, Tyne, Wear, Tees, Yorkshire Ouse, Trent (Humber), Witham, Welland, Nen, and Gt. Ouse.

3. Where are the following places, and for what are they noted?—

Sheffield, Portsmouth, Wick, Portree, Limerick, Coventry, Menai Strait, Lichfield, Port Rush, the Giant's Causeway.

Sheffield, in the West Riding of Yorkshire is famous for all kinds of cutlery, plated goods, &c.

Portsmouth is a seaport in Hampshire, and the most important naval station in the kingdom.

Wick, in Caithness, is the seat of the northern herring fishery.

Portree is a fishing port on the east of the Island of Skye.

Limerick, a city on the Shannon, in Ireland, is famous for lace, linen, gloves, distilleries, and its extensive trade.

Coventry, in Warwick, has great trade in watches and ribbons.

Menai Strait, between Carnarvon and Anglesea, is noted for the Britannia Tubular Bridge, forming part of the Chester and Holyhead railway.

Lichfield, a city of Staffordshire, has a fine cathedral, and was the birthplace of Johnson and Garrick.

Port Rush, on the north coast of county Antrim, has a good harbour, and is a favourite resort for sea-bathing.

The Giant's Causeway is a famous promontory and natural curiosity on the north coast of Antrim. It is composed of at least 30,000 lofty and regular columns which run out a great way into the sea, affording the finest specimens of columnar basalt in Europe.

History.

1. Give a short account of Bruce, as King of Scotland.

Bruce was crowned King at Scone in 1306, and immediately on hearing of this Edward I. vowed to destroy him. Surprised at Methven, Bruce was routed by Pembroke, and he became a fugitive in the Highlands and Western Isles till the spring of 1307. Making a descent on Carrick from Arran he took his own Castle of Turnberry from the English. After several romantic adventures he managed to reduce Carrick, Kyle, and Cunningham to obedience, and gained a victory over the superior forces of Pembroke at Loudon Hill. By this victory and the death of Edward I. at Burgh-on-Sands he was encouraged to continue his efforts against the oppressors of Scotland. In 1310 he had been so successful that he was acknowledged king by the clergy and the people.

Finding his authority established at home he invaded England twice, ravaging the border counties. He also gradually drove the English from various fortresses, till in 1314 Stirling Castle was the only one remaining in the hands of the enemy. The attempt to relieve this place by Edward II. resulted in the glorious victory for Scotland at Bannockburn. Bruce now free from foreign oppression spent the remainder of his life in harassing the English, or defending himself; in negotiating treaties with England or framing laws for consolidating the power he had acquired. By the treaty of Northampton (1328), the independence of Scotland was acknowledged, and Joanna, sister of Edward II., was married to David Bruce. King Robert lived the last two years of his life at Cardross, where he died 1329, in the 55th year of his age and the 23rd of his reign.

2. Explain the expression, 'It came with a lass, and it will go with a lass."

The meaning of the expression, as uttered by James V. of Scotland, is that the crown came to the Stuarts through Marjory Bruce, and it would go with the girl afterwards Mary Queen of Scots, whose birth was announced to him on his death-bed.

3. Date and give the results in the following battles:—Harlaw, Flodden, Solway Moss, and Langside.

Harlaw (1411).	The Earl of Mar defeated Donald, Lord of the Isles; this battle saved Scotland from being broken in two.
Flodden (1513).	James IV. defeated and slain by the English under Surrey.
Solway Moss (1542).	The Scots utterly routed by the English, this battle was a death-blow to James V.
Langside (1568).	The troops of Mary Queen of Scots were completely scattered by the Regent, Murray, and she was forced to flee from Scotland.

FIRST YEAR.

Pupil Teachers at end of First Year.

FIRST PAPER.

(Two hours and a half allowed for this paper.)

Dictation.

Write from dictation, in a neat hand, with correct spelling and punctuation, the passage read by the Inspector.

Penmanship.

Write in large hand, as a specimen of copy-setting, the word 'Diplomatist.'

Write in small hand, as a specimen of copy-setting, the sentence 'Dying is but being born anew.'

Arithmetic.

MALES.

1. Find the value of $\frac{8\frac{3}{5} \text{ of } 1\frac{4}{21}}{2\frac{2}{7} \text{ of } 1\frac{1}{11}} \div 5\frac{1}{2}$ of a £.

$$\frac{8\frac{3}{5} \text{ of } 1\frac{4}{21}}{2\frac{2}{7} \text{ of } 1\frac{1}{11}} \div 5\frac{1}{2} \text{ of a £} = £\frac{3}{16} \times \frac{\frac{42}{5} \times \frac{33}{21}}{\frac{15}{7} \times \frac{12}{11}}$$

$$= £\frac{3 \times 42 \times 25 \times 14 \times 22}{16 \times 5 \times 21 \times 33 \times 35}$$

$$= \underline{10\text{s.}} \text{ Ans.}$$

2. Divide ·1 separately by ·5, ·0005 and 5000.

(a)	(b)	(c)
·5)·1	·0005)·1	5000)·1
·2. Ans.	200. Ans.	·00002. Ans.

3. When 1 lb. troy of gold is worth £46$\frac{2}{3}$ find the weight of 6,930 half sovereigns.

$$\text{Weight of 6,930 half sovereigns} = 1 \text{ lb.} \times \frac{3{,}465 \text{ sovs.}}{46\frac{2}{3} \text{ sovs.}}$$

$$= \frac{138{,}600}{1{,}869} \text{ lbs.}$$

$$= \underline{74\frac{14}{23} \text{ lbs.}} \text{ Ans.}$$

FEMALES.

1. If 4 cwt. 3 qrs. 13 lbs. of rice cost £4 10s. 10d., how much may be bought for £3 10s. 8d.?

£ s. d.	£ s. d.	cwt. qrs. lbs.
4 10 10	: 3 10 8 ::	4 3 13
or	or	or
1,090d.	848d.	545 lbs.

$$\frac{545 \text{ lbs.} \times 848}{1{,}090} = 424 \text{ lbs.}$$

$$= \underline{3 \text{ cwt. } 3 \text{ qrs. } 4 \text{ lbs.}} \text{ Ans.}$$

2. If the wages of four men for 12 days be £6, what would be the wages of six men for 10 days?

4 men : 6 men
12 days : 10 days
:: £6 : amount required.

$$\frac{£6 \times 6 \times 10}{4 \times 12} = \underline{£7 \text{ 10s.}} \text{ Ans.}$$

3. If a family can live three months in the country for £24 10s. what will be required to keep them in town, supposing that £3 in the country will go as far as £4 in town?

£3 : £4 :: £24 10s. : expense for 3 months

$$\frac{£24 \text{ 10s.} \times 4}{3} = \underline{£32 \text{ 13s. 4d.}} \text{ Ans.}$$

Grammar.

'I now gave *over* any more thoughts of the ship, or *of* anything out of her, *except what* might *drive* on shore from her wreck, *as* indeed *divers* pieces of her afterwards *did*; but those things were of small use to me.'

1. Parse the words in italics.

2. Define the *adverb* and the *preposition*, and illustrate the distinction by examples from the above sentence.

1. Parsing:—

Over—adv. or separable prep. forming part of the verb 'gave.'

of—prep. relating 'thoughts' and 'anything.'

except—prep. relating 'anything,' and 'that' (understood in what).

what—pron. = that + which; *that* being a demonst. pro., neut., obj., gov. by 'except;' and 'which,' a simple rel., neut., sing., nom. to 'might.'

drive—irreg. intrans. verb, inf., pres., forming part of the comp. tense 'might drive.'

as—conj. adv. connecting two sentences and modif. 'did.'

divers—indef. adj. qual. pieces.

did—irreg. intrans. verb, *do*, *did*, *done*, indic., past., 3rd pers., pl., agr. with subj. 'pieces.'

2. An adverb modifies the action implied by the verb as to time, place, manner, &c. In the above sentence 'now,' 'over,' 'as,' 'indeed,' 'afterwards,' are adverbs.

A preposition shows the relation between nouns and pronouns, adjectives and nouns, verbs and nouns, as 'of' in 'thoughts *of* the ship,' 'on' in 'might drive *on* shore;' prepositions often form adverbial phrases with nouns.

3. Give the *plural* forms of the following pronouns:—mine, me, thine, she, him, my, whose, herself, whatever, whoso.

Singular.	*Plural.*
mine	ours.
me	us.
thine	yours.
she	they.
him	them.
my	our.
herself	themselves.

'Whose,' is the same in the plural, and 'whatever' and 'whoso' are only used in the singular.

SECOND PAPER.

(One hour and a half allowed for this paper.)

Geography.

1. Draw a map of Italy and the adjacent islands. Show mountains, rivers, and seaports.

2. Describe the course of the Rhone, mentioning tributaries and chief towns.

The Rhone rises on the western side of Mount St. Gothard and flows west to Martigny, then bending N.W. enters the Lake of Geneva. Leaving this lake it enters the Perte du Rhone, then flowing south to St. Cenis it bends to the N.W. to its junction with the Saone. From the confluence of the Saone to the Mediterranean the Rhone flows southwards, entering the sea by four mouths, and forming an extensive delta. The total length of the river is about 590 miles.

The tributaries of the Rhone are the *Saone* (which receives the Doubs) from the N., the *Isere* and *Durance* on the left, and the *Ardèche* on the right.

The towns are Martigny, Lausanne, Geneva, Auxonne, Besançon (on the Doubs), Maçons, Lyons, Vienne, Grenoble, Valence, Orange, Briançon, Avignon, Beaucaire, and Arles.

3. What do you know of Lombardy, Connaught, Cantyre, Osborne, Geneva, Tours, Zuyder Zee, Trieste?

Lombardy is a fertile division of north Itay watered by the Po and embracing the provinces of Bergamo, Brescia, Como, Cremona, Mantua, Milan, Pavia, and Sondrio.

Connaught is a province in the west of Ireland embracing the counties of Galway, Mayo, Sligo, Leitrim, and Roscommon. It is the rudest and most unimproved part of Ireland.

Cantyre, a peninsula of Scotland between the Firth of Clyde and the Atlantic, forming the S. end of Argyllshire.

Osborne is the Queen's residence in the Isle of Wight.

Geneva is a beautiful town on the L. of Geneva in Switzerland noted particularly for watch making.

Tours, a city of France, on the Loire, has important manufactures of silks, woollen, cloths, &c.

Zuyder Zee is a large gulf in the north of Holland; it was formerly an inland sea, but was united to the North Sea by inundations. Dutch engineers have contemplated the draining of this inlet.

Trieste, a town of Austria, at the head of the Gulf of Venice; it has extensive commerce and shipbuilding.

History.

1. Give a brief biography of Charles II.

Charles II., son of Charles I. and Henrietta Maria of France, was born May 29, 1630. On the breaking out of the Civil War, 1642, he was appointed to a command in the army. After Naseby, 1645, Prince Charles retired to the Continent, and was residing at the Hague when he heard of his father's death. Assuming the title of King of England, 1649, he was proclaimed King by the Scots, and crowned at Scone, 1650. Marching into England after Dunbar Drove he was attacked by Cromwell, who utterly defeated him. Escaping very narrowly from the battle-field he became a fugitive, but managed to reach the Continent, and was at Brussels when Cromwell died. On the resignation of Richard Cromwell; Monk negotiated for his return, and on May 29, 1660, as King Charles II., he made his triumphal entry into London. He had married Catherine of Portugal in 1662, but she had no children. His reign was a most disgraceful one, and the latter part of it was characterized by the most determined absolutism on his part, conjoined with mean dependence on secret money from France; by ceaseless intrigues in his court, and by restlessness among his people. He died a Romanist on 6th February, 1685, aged 55 years. The abolition of military tenures, and the Habeas Corpus Act were almost the only benefits conferred by Parliament throughout his reign.

2. Give a short account of the last Jacobite rebellion, with dates.

In 1745 Charles Edward Stewart, son of the Old Pretender, encouraged by the King of France, landed in Inverness-shire with seven officers. Welcomed by the people of Edinburgh, he took up his quarters in Holyrood Palace, and was soon strong enough to attack the Loyalists, under Cope, whom he utterly routed at Prestonpans. After wasting six weeks in frivolity he marched into England, took Carlisle, and by way of Manchester reached Derby, where his Highland chiefs refused to go any further. Retreating towards Scotland he crossed the Border, defeated General Hawley at Falkirk, but, pursued by the Duke of Cumberland, he continued northwards, and, making a stand at Culloden, his forces were completely scattered, 1646.

Becoming a fugitive, he was hunted among the hills of the north, and though a price was set upon his head no one ever betrayed him. Assisted by Flora Macdonald, he managed to elude his pursuers, and at length set sail for France, almost at the same spot where he had landed fifteen months before.

Composition.

1. Write the substance of the passage read to you, *or*,

2. Write a letter on 'Christmas.'

A LETTER ON CHRISTMAS.

Glasgow, June 26th, 1866.

Dear Sir,

The return of Christmas calls yearly for a new crop of sentiment. It has become quite a custom in Scotland to hold Christmas as our fellow-subjects the English do. In former times New Year's Day was the great Scotch holiday of the winter season, but it is now giving place to Christmas, which brings the family together for eating, drinking, and general festivity and congratulation. December 25th, generally accepted as the birthday of the Saviour, is gradually losing its sacred character, and becoming entirely a secular holiday. The houses are decked with a profusion of evergreens, and the literature of the season has a certain gorgeousness about it from the reward cards of the school to the brilliantly illuminated copies of favourite authors, and the pretty books of Kate Greenaway and other clever limners.

Holiday games, pies and plum-pudding make the festival pleasant to the young, and the elders live over again the yuletide of former years in watching the merriment of the children. Christmas tales, coloured by superstition, are many, and the advent of the day bringing 'peace and good-will to man' is welcomed with chimes of bells, and, in the more primitive parts of England by carol-singing.

These are but a few desultory ideas on the happy time of Christmas.

I am, dear Sir,
Yours faithfully,
WILLIAM TEACHER.

H. M. S., Esq.,
Inspector of Schools.

Music.

A quarter of an hour allowed for this Paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa notation will be found at the end.)

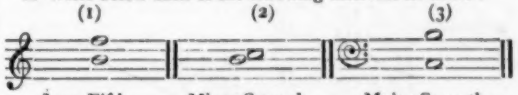
STAFF NOTATION.

1. Re-write the following (1) doubling the value of every note, and (2) state below each its pitch name (as E or *Mi*, &c.).

G C G E F G A D B C

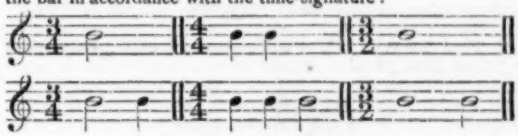
2. Write below each of the following intervals its name:

(1) (2) (3)



Imp. Fifth Minor Second Major Seventh

3. Add *one* note to each of the following examples to complete the bar in accordance with the time-signature:



TONIC SOL-FA NOTATION.

A quarter of an hour allowed for this paper.

1. What is the name of the interval (1) between te_1 and *fah*, (2) between te_1 and *doh*, (3) between *doh* and *te*?

2. Write the pulse signs (1) for two-pulse measure, (2) for four-pulse measure, and (3) three-pulse measure.

3. Write (using four-pulse measure) one note four pulses in value, and two notes each two pulses in value.

1. (1) Imp. 5th. (2) Minor 2nd. (3) Major 7th.
2. (1) | : | (2) | : | : | (3) | : : |
3. |1 :— |— :— |1 :— |1 :— |

SECOND YEAR.

Pupil Teachers at end of Second Year.

FIRST PAPER.

(Two hours and a half allowed for this paper.)

Dictation.

A short passage of prose to be selected by the Inspector, read over once, and then slowly dictated.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word 'Diplomatist.'

Write, in small hand, as a specimen copy-setting, the sentence 'Dying is but being born anew.'

Arithmetic.

MALES.

1. How much must be invested in the 3¾ per cents. at 84¼ to produce an annual income of £100?

(1.) 3¾ : 100 :: £84¼ : sum required.

$$\frac{£337 \times 100 \times 4}{4 \times 15} = £2246\ 13s.\ 4d.\ \text{Ans.}$$

2. A tax of £6 18s. 8d. falls to be paid by three proprietors in the proportion of the annual values of their properties, which are £30, £40 and £60 respectively; how much does each pay?

£30 + £40 + £60 = £130

∴ the 1st pays $\frac{30}{130}$
,, 2nd ,, $\frac{40}{130}$
,, 3rd ,, $\frac{60}{130}$

} of £6 18s. 8d.

£	s.	d.
1	12	0
2	2	8
3	4	0

3. Find the difference between the simple and the compound interest on £150 for 3 years at 4 per cent. per annum.

(a.) Simple Interest.

$\frac{£150 \times 3 \times 4}{100}$ = £18.

(b.) Compound Interest.

$\frac{1}{25}$ of £150
6 Int. for 1st yr.
156 Prin. for 2nd yr.
6·24 Int. ,, ,,
162·24 Prin. for 3rd yr.
6·4896 Int. ,, ,,
168·7296 amt. for 3 yrs.
150
£18.7296 Int. ,, ,,
20
14·592s.
12
7·104d.

(c.)

	£	s.	d.
Com. Int. =	18	14	7·104
Simp. Int. =	18	0	0
Diff. =		14	7·104d. Ans.

FEMALES.

1. Simplify $\frac{8\frac{2}{5} \text{ of } 1\frac{4}{11}}{2\frac{1}{14} \text{ of } 1\frac{1}{11}} \div 5\frac{1}{2}$

$$\frac{8\frac{2}{5} \text{ of } 1\frac{4}{11}}{2\frac{1}{14} \text{ of } 1\frac{1}{11}} \div 5\frac{1}{2} = \frac{\frac{42}{5} \times \frac{15}{11}}{\frac{15}{14} \times \frac{12}{11}} \times \frac{1}{11}$$

$$= \frac{42 \times 25 \times 3 \times 14 \times 22}{5 \times 21 \times 16 \times 33 \times 35}$$

$$= \frac{1}{4} \text{ Ans.}$$

2. Find the sum of $\frac{1}{3}$ of half-a-crown, $\frac{1}{8}$ of a £, and $\frac{4}{15}$ of a £, and $\frac{1}{75}$ of £1 5s.

	s.	d.
$\frac{1}{3}$ of 2s. 6d. =	0	10
$\frac{1}{8}$,, £1 1s. =	3	6
$\frac{4}{15}$,, £1 =	5	4
$\frac{1}{75}$,, £1 5s. =	0	4
Total =	10	0 Ans.

3. Explain the terms 'greatest common measure,' 'least common multiple,' 'improper fraction,' 'mixed number.'

When one number is contained an exact number of times in each of two or more numbers, it is called a common measure of those numbers, and the greatest number so contained in those numbers is called their G.C.M.

A number which exactly contains each of two or more other numbers is called a common multiple of those numbers, and the least number which exactly contains them is called their L.C.M.

An improper fraction is one whose numerator is not less than the denominator, as $\frac{8}{8}$, $\frac{10}{7}$, $\frac{11}{4}$.

A mixed number consists of an integer and a fraction, as $7\frac{1}{2}$.

4. A can do a piece of work in 7 hours, B in $5\frac{1}{2}$ hours, and C can work twice as fast as A. In what time will they do it all working together?

A does $\frac{1}{7}$ or $\frac{11}{77}$ in 1 h.
B ,, $\frac{14}{77}$,,
C ,, $\frac{2}{7}$ or $\frac{22}{77}$,,
∴ A, B, and C together $\frac{47}{77}$,,
or they will do the whole in $\frac{77}{47}$ h. *i.e.* $1\frac{30}{47}$ h. Ans.

Euclid.

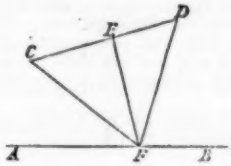
(Book-work, well done, will get the mark 'G.')

1. Is it a sufficient definition of a parallelogram to say that it is a figure whose opposite sides are parallel? Give a reason for your answer.

It is not a sufficient definition, for in Euclid's Elements the term 'parallelogram' is restricted to 'four-sided' figures, and in the above the figure might have any even number of parallel sides. Therefore the definition should read: A parallelogram is a four-sided figure whose opposite sides are parallel.

2. The complements of the parallelograms which are about the diagonal of any parallelogram are equal. Prop. 43, Bk. I.

3. Find a point in a straight line equally distant from two given points.



Let AB be the given straight line, and C, D, the two given points.

Join CD and bisect CD in E. From E draw EF perpendicular to CD meeting AB in F. F is the point required. Join CF, DF.

Because CE = DE, and EF is common to the two triangles CEF, DEF, and the angles CEF, DEF are right angles, ∴ the base CF = base DF, and ∴ F is equally distant from the given points C, D. (Bk. I. Prop. 4.) Q. E. F.

N.B.—This is impossible when the line joining the points is perpendicular to the given line.

Grammar.

'In *short*, you *will* find *that* in the *higher* and better class of works of fiction and imagination you possess all you *require* to strike your grappling-irons into the souls of the people, *and* to *chain* them willing *followers* to the car of civilization.'

1. Analyse the above passage.

2. Parse the words in italics.

SENTENCES	KIND	SUBJECT	PREDICATE	COMPLETION OF PRED.	EXTENSION OF PRED.
(a) In short you will find	Prin.	You	will find	(b)	in short (*manner*)
(b) that in the higher and better class of works of fiction and imagination you possess all	sub. noun obj. of (a)	You	possess	all	that (*connect*) in the higher ....and imagination (*place*)
(c) (that) you require to strike your grappling-irons into the souls of the people and to chain them willing followers to the car of civilization.	sub. adj. to 'all' (b)	You	require	(that)	to strike..... people (*purpose*) and to chain... .....to the car of civilization (*purpose*)

Parsing.

Short—adj. used substantively, neut., sing., obj , gov. by 'in.'
will—aux. verb., indic., pres., 2nd pers., plur., agr. with 'you,' forming with inf. 'find' future indic.
that—subord. conj. connect. (b) with (a).
higher—adj., compar. deg., qual. 'class.'
require...reg, trans. verb. indic., pres., 2nd pers. plur. agr. with 'you.'
and—simple co-ord. conj., connect. 'to strike,' &c., with 'to chain,' &c.
chain—reg. trans. verb, inf., pres., of trans. verb 'to chain.'
followers—com. noun, mas. or fem., plur., obj., gov. by 'to chain.'

3. Show wherein prepositions and conjunctions are *like* and wherein they are *unlike*.

Conjunctions show the relation of one *thought* to another. Prepositions show the relation of one *notion* to another. For example, 'You will hear from me *before* I return;' 'before' is a conj. 'Do not stand *before* the window' 'before' is a prep. Prepositions can form adverbial phrases along with nouns, &c., as, 'in a moment,' 'at once.' Conjunctions are never used for that purpose, because they do not govern cases like the preposition.

4. When is a noun said to be in the nominative, possessive, and objective cases respectively?

A noun is said to be in the nominative—
(1) when it is the subject of a verb;
(2) in apposition with a noun or pron. in the nom. case,
(3) as the complement of an intrans. or pass. verb of incomplete predication,
(4) as a nom. absolute,
(5) as a nom. of address.

A noun is in the possessive—
(1) when it is attached to some noun to which it forms an attributive adjunct, and on which it is sometimes said to depend.

A noun is in the objective—
(1) as the direct obj. of a transitive verb part. or gerund.
(2) as an indirect obj. or as a secondary obj. after a pass. verb when its active voice takes two objects,
(3) in apposition with a noun or pron. in obj. case,
(4) as the complement of a trans. verb of incomplete predication,
(5) after an infinitive mood, in a clause,
(6) as an adverbial adjunct,
(7) after prepositions,
(8) as a cognate obj. 'He ran a race.'

SECOND PAPER.

(*Two hours allowed for Females, and two hours and a half allowed for Males, for this paper.*)

Geography.

1. Draw a map of the coast from Cape Comorin to Singapore, showing islands, river mouths, and chief towns.

2. Enumerate the British possessions in Europe; mention how and when they were acquired, and show in what way they are of advantage to Britain.

The British possessions in Europe are the Channel Islands, Heligoland, Gibraltar, Maltese Islands, and Cyprus. The Channel Islands became the property of the British Crown at the Norman Conquest, 1066. Heligoland was taken from the Danes, 1807, and ceded to Britain at the peace of 1814. Gibraltar was taken by Sir George Rooke from the Spaniards, 1704, and formally ceded to Britain by the Treaty of Utrecht. The Maltese Islands, first given to the Knights of St. John, were taken by the French, but retaken by the British and Maltese in 1800. Cyprus was transferred to England at the close of the Russo-Turkish War in 1878, an annual contribution being payable to Turkey.

These dependencies are valuable as stations to shelter our fleets, and consequently to protect our commerce. They serve as depôts where ships may call to take in water, provisions, or coal. Cyprus was occupied for the purpose of checking Russian aggression, and protecting our route to India.

3. Give the position and other particulars regarding Delhi, Falkland Islands, Nova Scotia, Mauritius, Perim.

Delhi, long capital of the Mogul Empire, is situated on the banks of the Jumna. In 1857 it was seized by the Sepoys, but was retaken by the British. It is seven miles in circumference, and enclosed on three sides by walls constructed of large blocks of red granite.

The Falkland Islands are a cluster in the South Atlantic, about 300 miles east of Magellan. They are about 100 in number, but only two are of any importance. Britain holds them mainly for the protection of the whale-fishery.

Nova Scotia consists of the peninsula of Nova Scotia proper, connected with New Brunswick by an isthmus 11 miles broad, and the adjoining island of Cape Breton. It was ceded to Britain in 1714, and Cape Breton in 1763. They were united as one province in 1819, and admitted to the Dominion 1867.

Mauritius is an island in the Indian Ocean east of Madagascar. The majority of the population consists of Coolies who are engaged on the sugar plantations. It was colonized by the Dutch, then came into the hands of the French, from whom it was captured by the British in 1810.

Perim is a rocky island, about 3 miles long, situated near the mouth of the Red Sea. It was occupied by order of the governor of Aden in 1859 for the purpose of building a lighthouse upon it.

History.

1. What illegal means did the Stewart kings employ to raise money?

The following is a list of the principal illegal methods of raising money under the Stewarts; viz.:
Benevolences, laying fines on the people, creating and selling titles of nobility, sale of monopolies, levying taxes without the consent of parliament, forced loans, the tax of ship-money, misapplication of sums raised for certain purposes, and secretly receiving money from the French King.

2. Describe the battle of Dunbar, Sedgemoor, *or* Culloden.

Battle of Dunbar.—To put down the Scots who acknowledged Charles II., Cromwell set out for Scotland and crossed the Tweed with sixteen thousand men. The Scots had ordered an army of thirty thousand to be placed under the Earl of Leven, though the real command was given to his son David Leslie. When Cromwell came up with the Scotch forces he found them so advantageously posted that no device of his could draw them. Charles paid a visit to the Scotch camp, and was forced to sign several humiliating declarations. While this was going on Cromwell was actually retreating to Dunbar. Leslie removed his army to Doon Hill, within two miles of his foes. So great was his danger, that Cromwell is said to have contemplated embarking his infantry on board the fleet, and escaping with his cavalry to Berwick. On the side of the Scots the fear was, lest the enemy should escape; the committee therefore compelled Leslie to quit his vantage-ground and give battle.

At first the Scots had the advantage, and drove some English cavalry from their position; but just then the sun arose, and Cromwell exclaiming 'Let the Lord arise and scatter his enemies,' ordered the advance. The Scottish Lancers broke and fled. This occasioned a panic which spread along the whole line; throwing down their arms the Scots fled and were pursued by the English for eight miles. The immediate result of this victory was the submission of the capital, and the whole of the country south of the Forth; Edinburgh Castle held out for three months and then surrendered.

Battle of Sedgemoor.—Faversham having been despatched with an army to stop the advance of Monmouth in his invasion, pitched his camp on the plain of Sedgemoor, about three miles from Bridgewater. Monmouth attempted to surprise the enemy by a night attack, which failed by reason of a broad ditch which could not be crossed. The Royal army, aroused by the attempt, delivered a volley which drove back the cavalry. Monmouth then advanced with the infantry, but they were taken in front and flank by Faversham's troops. The peasants and miners fought bravely with their scythes and forks long after Monmouth fled from the field. Of the Royal army about 300 fell; of the rebels 1,000 lay dead on Sedgemoor, and many hundreds were made prisoners (1685).

Battle of Culloden.—The last battle of Charles-Edward Stewart, the Young Pretender, was fought at Culloden, 1646. The Highland army was drawn up in three lines, the first consisting of the Athole brigade, the second of the Gordons and others, the third of two regiments under Lord Ogilvy; the Prince taking his stand on an eminence where he had a complete view of the whole field.

The English army continued to advance till within a mile of the position occupied by the Highland army, when the Duke of Cumberland ordered a halt, and after reconnoitering the position of the Highlanders again formed his army for battle in three lines.

The dispositions of both armies are considered to have been well arranged, but both were better calculated for defence than for attack. About one o'clock in the afternoon the Royal guns opened fire upon the rebels, which the Highlanders answered with a gallant charge. This was met with such storm of grape and musket-shot that few reached the line of English bayonets. On the left the Macdonalds, who had been deprived of their accustomed position of honour on the right, stood gloomily nursing their wrath, and allowed themselves to be cut down in scores. The battle was over in less than an hour, and it was with difficulty that Charles was persuaded to leave the scene. Fortunately, the English did not follow up the advantage by immediate pursuit, or Charles could not have escaped.

Composition.

Write full notes of a lesson on 'an Arch' or on 'an Umbrella.'

AN UMBRELLA.

Introduction.—Draw from the children the necessity of sheltering ourselves from the weather—frequency of rain in this country—and the need of coverings to protect ourselves—elicit water-proofs, umbrellas (*show one*), and compare with parasol.

Parts.—*Stick* like a staff—what made of? *handle* of various materials—plain—ornamented—carved—ivory—bone—silver, &c.

Ribs—formerly whalebone—now wire—show how fastened to *stretchers*, also of wire; *runners* for opening or shutting the umbrella. *Cover* made of silk, cotton, Alpaca—gingham—dagmar; *ferrule* for the top of the stick.

History and Uses.—Formerly used as a sun-screen—whence its name *umbrella*, from 'umbra,' a shadow—about the reign of Anne used as a protection from the rain by women—first male who used it in public was Jonas Hanway, who was much jeered at—soon the want of it was considered a sign of poverty—now its manufacture is a flourishing trade—gives employment to thousands of men, women, and children. (*Compare convenience of a light umbrella—which is almost as handy as a walking-stick with a tent or waterproof. Call attention to its convexity* (why?) *and likeness to the roof of a bell-tent for turning the rain, also mention the white umbrella of artists as a screen from the sun*).

Latin.

FIRST STAGE.

(The answers to be written on a separate paper.)

1. Decline together *ingens opus and melior mensa.*

2. Give the genitive singular, the gender, and the declension of *corpus, manus, filius, nox, dies.*

3. Write out the imperative of the verb 'to be,' and the future simple passive of the verb 'to hear.'

Optional.

Translate into Latin:—

(*a*) The voices of women and children have been heard in the city.

(*b*) Boys love your parents!

(1) Latin:—

(*a.*)

	Singular.		Plural.	
N.	Ingens	opus	Ingentia	opera
G.	Ingentis	operis	Ingentium	operum
D.	Ingenti	operi	Ingentibus	operibus
A.	Ingens	opus	Ingentia	opera
V.	Ingens	opus	Ingentia	opera
A.	Ingente	opere	Ingentibus	operibus

(*b.*)

N.	Melior	mensa	Meliores	mensæ
G.	Melioris	mensæ	Meliorum	mensarum
D.	Meliori	mensæ	Melioribus	mensis
A.	Meliorem	mensam	Meliores	mensas
V.	Melior	mensa	Meliores	mensæ
A.	Meliore	mensâ	Melioribus	mensis

(2)

Noun.	Genitive Sing.	Gender.	Declension.
corpus	corporis	neut.	third
manus	manûs	fem.	fourth
filius	filii	mas.	second
nox	noctis	fem.	third
dies	diei	mas. or fem. in sing. mas. only in pl.	fifth

(3) (*a.*)

Imperative of the verb 'to be.'

Sing.	Plur.
2. Es, or esto.	Este or estote.
3. Esto.	Sunto.

(*b.*)

Futnre simple passive of the verb 'to hear.'

Sing.	Plur.
1. Audiar.	Audiemur.
2. Audieris, audiere.	Audiemini.
3. Audietur.	Audiantur.

Optional.

(*a*) Voces fœminarum et liberorum in urbe sunt auditæ.

(*b*) Pueri, parentes amate!

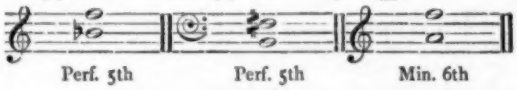
Music.

A quarter of an hour allowed for this Paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa notation will be found at the end.)

1. Write below each of the following intervals its name (major second, &c.):

(1) (2) (3)



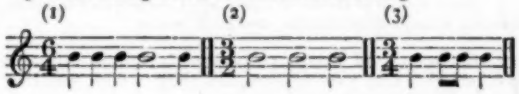
Perf. 5th Perf. 5th Min. 6th

2. Write the key-signatures of each of the following major keys:

(1) D major. (2) E flat major. (3) A flat major.

3. Add time-signatures to each of the following:

(1) (2) (3)



TONIC SOL-FA NOTATION.

A quarter of an hour allowed for this Paper.

1. (1) Which tone of the scale has a grave solemn effect, and (2) which has a keen, expectant effect?

2. Write (1) the pulse signs for six-pulse measure, (2) nine-pulse measure, and (3) four-pulse measure.

3. What is the name of the interval between (1) *doh* and *soh*, (2) *me* and *te*, and (3) *lah* and *fah*[1]?

1. (1) lah (2) te.

2. (1) | : : | : : | (2) | : : | : : | : : | : : | (3) | : : | : : |

3. (1) Perf. 5th. (2) Perf. 5th. (3) Minor 6th.

THIRD YEAR.

Pupil Teachers at end of Third Year.

FIRST PAPER.

(Two hours and a half allowed for this paper.)

Dictation.

A short passage of prose to be selected by the Inspector, read over once, and then slowly dictated.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word 'Diplomatist.'

Write, in small hand, as a specimen of copy-setting, the sentence 'Dying is but being born anew.'

Arithmetic.

MALES.

1. How do the 3 per cents. stand when they yield 4 per cent?

£4 : £3 :: £100 : price required

$$\frac{£100 \times 3}{4} = \underline{£75.}\ \text{Ans.}$$

2. Find the difference between the simple and the compound interest on £250 10s. 0d. for 3 years at $4\frac{1}{2}$ per cent. per annum.

Simple Interest.

(*a*) $\dfrac{£250\ 10s. \times 3 \times 4\frac{1}{2}}{100} = \underline{£33\ 16s.\ 4{\cdot}2d.}$ Ans.

Compound Interest.

(*b*) At $4\frac{1}{2}$ per cent. the principal increases $\frac{9}{200}$ yearly.

£	
250·5	Prin. for 1st year
11·2725	Int. ,, ,, ,,
261·7725	Prin. ,, 2nd ,,
11·7797	Int. ,, ,, ,,
273·5522	Prin. ,, 3rd ,,
12·3098	Int. ,, ,, ,,
285·8621	Amount for 3 years
250·5	

£35·3621...Comp. Int. for 3 yrs.

20

7·242...s.

12

2·908d.

	£	s.	d.
Comp. Int. =	35	7	2·9
Simple Int. =	33	16	4·2
Diff. =	1	10	10·7. Ans.

FEMALES.

1. Express 5s. $1\frac{3}{4}$d. as the decimal of £5 2s. 11d.

$$\frac{5s.\ 1\frac{3}{4}d.}{£5\ 2s.\ 11d.} = \frac{247\ \text{far.}}{4940} = \frac{1}{20} = \underline{\cdot05.}\ \text{Ans.}$$

2. Divide £31 8s. among 6 men and 11 boys, giving a boy ·525 of a man's share.

If a man gets 1 share, 6 men get 6 shares

∴ a boy gets ·525 ,, 11 boys get 5·775 ,,

11·775

(*a*) Hence a man's share = $\dfrac{£31{\cdot}4}{11{\cdot}775} = £2{\cdot}6$

= £2 13s. 4d. Ans.

(*b*) ∴ A boy's share = £2·6 × ·525 = £1 8s. 0d. Ans.

3. Divide ·04 by 20, ·4 by ·002, ·0004 by ·0002, and 400 by ·02. Prove the truth of one of your results by vulgar fractions.

(*a*) 20) ·04 ·002 Ans.

(*b*) ·002) ·4 200 Ans.

(*c*) ·02) 400 2000 Ans.

Proof of (*a*)

$$\cdot04 \div 20 = \tfrac{4}{100} \div \tfrac{20}{1} = \tfrac{4}{100} \times \tfrac{1}{20} = \tfrac{4}{4} \times \tfrac{1}{1000} = \tfrac{1}{1000} = \cdot002$$

4. Find the value of $\dfrac{7\frac{1}{2}}{6\frac{1}{2}} + \dfrac{11\frac{1}{2} - 2\frac{3}{5}}{11\frac{1}{2} + 2\frac{3}{5}} \times 10\tfrac{9}{13} - 7\tfrac{1}{8}$.

$$\frac{7\frac{1}{2}}{6\frac{1}{2}} + \frac{11\frac{1}{2} - 2\frac{3}{5}}{11\frac{1}{2} + 2\frac{3}{5}} \times 10\tfrac{9}{13} - 7\tfrac{1}{8} = 1\tfrac{1}{13} + \frac{115 - 24}{115 + 24} \times \tfrac{139}{13} - 7\tfrac{1}{8}$$
$$= 1\tfrac{1}{13} + \tfrac{91}{139} \times \tfrac{139}{13} - 7\tfrac{1}{8}$$
$$= 1\tfrac{8}{13} + 7 - 7\tfrac{1}{8}$$
$$= 8\tfrac{16}{104} - 7\tfrac{13}{104}$$
$$= \underline{1\tfrac{3}{24}.}\ \text{Ans.}$$

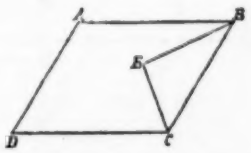
Euclid.

Book-work, well done, will get the mark 'G.'

1. If a side of a triangle be produced, the exterior angle is equal to the sum of the two interior opposite angles,—Bk. I. Prop. 32.

2. If a straight line be bisected and also produced, the square on the whole line thus formed, and the square on the produced part are together double of the square on half the line bisected and of the square on the line made up of the half and the part produced.—Bk. II. Prop. 10.

3. Straight lines bisecting two adjacent angles of a parallelogram meet at right angles.



3. Let ABC, BCD, two adjacent angles of the parallelogram ABCD, be bisected respectively by the straight lines BE, CE. By I. 28 the angles ABC, BCD are together equal to two right angles, and therefore EBC, ECB being less than two right angles, EB, EC will meet. Let them meet in E; then EBC, ECB are together equal to one right angle, and since the three angles of every triangle are together equal to two right angles (I. 32) therefore the remaining angle BEC must be a right angle. Q E. D.

Algebra.

1. Simplify $\dfrac{\dfrac{a+b}{a-b} + \dfrac{a-b}{a+b}}{\dfrac{a+b}{a-b} - \dfrac{a-b}{a+b}}$

$$\frac{\frac{a+b}{a-b} + \frac{a-b}{a+b}}{\frac{a+b}{a-b} - \frac{a-b}{a+b}} = \frac{a^2 + 2ab + b^2 + a^2 - 2ab + b^2}{a^2 + 2ab + b^2 - (a^2 - 2ab + b^2)}$$
$$= \frac{2a^2 + 2b^2}{4ab}$$
$$= \frac{a^2 + b^2}{2ab}.\ \text{Ans.}$$

2. Find the greatest common measure of $4x^3 + 3x - 10$ and $4x^3 + 7x^2 - 3x - 15$.

$$4x^2+3x-10)\,4x^3+7x^2-3x-15\,(x+1$$
$$4x^3+3x^2-10x$$
$$4x^2+7x-15$$
$$4x^2+3x-10$$
$$4x-5)\,4x^2+3x-10\,(x+2$$
$$4x^2-5x$$
$$8x-10$$
$$8x-10$$

$\therefore 4x-5 =$ G. C. M.

3. Divide the number 60 into two parts, such that a seventh of one part may be equal to an eighth of the other part.

Let x = the less part
then $60 - x$ = the greater
thence $8x = 7(60 - x)$
$8x = 420 - 7x$
$8x + 7x = 420$
$15x = 420$
$x = 28$ the less. Ans.
$\therefore 60 - 28 = 32$ the greater. Ans.

Grammar.

'*Sing*, heavenly muse! *that* on the secret top
Of Oreb or of Sinai *did'st inspire*
That shepherd who *first taught* the chosen *seed*
In the beginning how the heavens and earth
Rose out of chaos.'

1. Analyse the above passage, and parse fully the words in italics.

Sentences	Kind	Subject	Predicate	Completion of Pred.	Extension of Predicate
(*a*) Sing, heavenly muse!	prin.	(thou) heavenly muse	Sing		
(*b*) that on the secret top of Oreb or of Sinai didst inspire that shepherd	subord. adj. to (*a*)	that	didst inspire	that shepherd (obj.)	on the secret top of Oreb or of Sinai (place)
(*c*) who first taught the chosen seed in the beginning	subord. adj. to (*b*)	who	taught	the chosen seed (obj.)	first (time) in the beginning (time)
(*d*) how the heavens and earth rose out of chaos.	subord. adv. to (*c*)	the heavens and earth	rose		how (manner) out of chaos (place)

Parsing.

Sing—irreg. intrans. verb, *sing, sang, sung*, imper., pres., 2nd pers., sing., agr. with (thou).

that—simple rel. ante. (thou) 2nd pers., mas. or fem., sing., nom. to 'did'st inspire.'

did'st inspire—reg. trans. verb, indic., past. (emph. form), 2nd pers., sing., agr. with 'that.'

first—adv. with somewhat of an adj. force, qual. who and mod. 'taught.'

taught—irreg. trans. verb, *teach, taught, taught*, indic., past., 3rd pers., sing., agr. with who.

rose—irreg intrans. verb, *rise, rose, risen*, indic., past., 3rd pers., plur., agr. with 'heavens and earth.'

2. Write out and give the meaning of the Latin prepositions in the following words:—adhere, collection, elation, suppose, extract, subterfuge, subterranean, confer.

Words	*Latin Prepositions*	*Meaning*
adhere	ad	to
collection	col for con	together
elation	e	out of
suppose	sub	under
extract	ex	out of
subterfuge	subter	beneath
subterranean	sub	under
confer	con	together

3. Give, with examples, the meaning of ante, de, inter, ob, super, sub.

Prefixes	*Meaning*	*Examples*	
ante	before	antedate	antecedent
de	down, from	depose	detract
inter	between	intervene	interpose
ob	against	obstruct	oppose
		occur	omit
super	above	superior	supersede
sub	under	submit	succour
		suppose	

SECOND PAPER.

(*Two hours allowed for Females, and two hours and a half allowed for Males, for this paper.*)

Geography.

1. Sketch the coast line from the mouth of the Ganges to Singapore, indicating the river-mouths and chief sea-ports.

2. Name the divisions of Africa that touch the Mediterranean Sea, with the towns and their position in each, and describe in detail one province in the possession of a European Power.

The divisions of Africa touching the Mediterranean Sea are Egypt, Tripoli, Tunis, Algeria, and Morocco.

Algeria, belonging to France, is bounded on the North by the Mediterranean, West by Morocco, South by the Sahara, and East by Tunis. The Atlas chain of mountains runs through its entire length, which is about 550 miles. The valleys are well watered and fertile, and the hills are covered with fruit trees.

The French are now colonizing the country and introducing the arts and civilization of Europe. They have divided it into three provinces: Algiers in the centre, Oran in the west, and Constantine in the east.

The principal towns are Algiers, Constantine, Bona, Oran, and Tlemezen.

The cultivation of vegetables occupies a good deal of the attention of the people, and there is a very considerable export of produce, especially potatoes and peas, for the Paris and London markets.

3. What, where, and for what noted are: Massowah, Peshawur, Soudan, Congo, Zambesi.

Massowah is a seaport of Egypt on an island in the Red Sea, the outlet of the Abyssinian trade in ivory, musk, wax, and coffee.

Peshawur is a city of the Punjaub, situated in a beautiful plain, watered by the Cabool, and surrounded by lofty mountains near the Khyber Pass. It is one of the largest military stations under the Government of British India.

Soudan is the name applied to the region of Central Africa lying south of the Sahara to the east of Senegambia, and to the west of Abyssinia. The Soudan best known to us is the Egyptian or Eastern Soudan, annexed by Egypt since 1871, and lying along the shores of the Red Sea to Berber, and noted for General Gordon's Expedition to Khartoum, where he perished in 1885, a day or so before the arrival of a British Relief-Expedition.

Congo is great river of West Africa, which rises in the equatorial lake region, and enters the Atlantic by an estuary six miles wide in Lower Guinea. It is noted for the numerous attempts to clear up the mystery regarding its source and course. The most successful explorer of this river was Stanley (1876—77) who regarded it as the greatest of African rivers, and proposed to call it the Livingstone. The Congo Region is said to be unrivalled as a field for colonization.

The *Zambesi* is a large river of South Africa, formed by the junction of three streams. It flows. SE. through the Makololo country, then N.E., and finally easterly through a fertile and populous district, and enters the Channel of Mozambique by several mouths. About 800 miles from the sea Dr. Livingstone discovered what he named the Victoria Falls, where the river contracted from 1,900 yards to 60 or 80 ft. broad, rushes over a precipice of 100 ft. into a zigzag gorge of basaltic rock, nowhere more than 200 ft. wide. Like the other great African rivers the Zambesi periodically overflows its banks.

History.

1. Give a full account of the Petition of Right and the Habeas Corpus Act.

The *Petition of Right*, passed in the reign of Charles I. (1628), was a petition declaring that the people of England had certain rights secured them by ancient statute, that these had recently been infringed, and praying for a redress of grievances.

1. Persons refusing to advance money to the King, unless required to do so by Act of Parliament, should not be imprisoned, questioned, or otherwise molested for their refusal.

2. Persons should not be imprisoned, outlawed, or in any way punished except by the law of the land, and that it was contrary to the statutes of the realm for the King to commit anyone to prison without a specific charge being made against him.

3. Soldiers should not be billeted in private houses against the will of the owners.

4. That Commissions for trying offenders by martial law should no longer be in force, and some persons had wrongfully been put to death under martial law while notorious offenders had been allowed to escape.

The *Habeas Corpus Act*, passed in the reign of Charles II., 1679, declared that :—

1. All persons, except those charged with treason or felony, could demand from one of the judges a writ of *Habeas Corpus*, directing the jailer to bring them before him, so that the legality of their detention might be tested.

2. All persons charged with treason or felony must be tried at the next sesssions after commitment, or else admitted to bail ; and if not tried at the second sessions after commitment must be discharged.

3. No person could be recommitted for the same offence.

4. No person was to be sent as a prisoner to Scotland, Ireland, Jersey, Guernsey, or any place beyond the seas within or without the King's dominions.

5. Heavy penalties be imposed on all those who violate the provisions of this act.

2. Describe carefully the route followed by Charles Edward Stuart in his invasion.

Landing at Moidart, he raised his standard at Glenfinnin, marched southwards to Locheil, went through Badenoch into the vale of Atholl, and reached Perth. From Perth he went to Dumblane, and then he marched within a mile of Stirling Castle, traversed the field of Bannockburn, quartered his men in Falkirk, and lodged himself in Callendar, from which place he passed by way of Linlithgow to Edinburgh. Sir John Cope having gathered an army and marched to Prestonpans, Charles marched to meet him, and a battle was fought, in which Charles was victorious. He lay that night at Pinkie, and returned the next day to Edinburgh. After halting some weeks at Edinburgh he marched southwards, and halted one day at Kelso, he then marched down Liddesdale, and crossing the River Esk, he occupied a place called Reddings, in Cumberland, on the road to Carlisle. Then he ordered the whole army to march to Brampton, seven miles from Carlisle, but no English troops having been either seen or heard of, he sent a detachment to besiege Carlisle, which surrendered. Charles then made a triumphal entry into that city, leaving 200 men to guard it. He marched on again with an army reduced to 4,500 men. There was a short halt at Penrith, and then they pushed on to Preston. From Preston they marched to Wigan, and then to Manchester, which surrendered. They resumed their march southwards, crossed the Mersey, and entered Macclesfield, and they then marched to Derby. His chiefs would go no further, and he began to retreat towards Scotland. They retreated by way of Ashburn and Leek to Manchester, and by Wigan to Preston. From Preston they went to Lancaster, and then to Penrith. Charles re-crossed the Scottish Border, and marched to Annan. All the divisions of the army then met at Glasgow. They left Glasgow and began their march towards Stirling, by Kilsyth. Charles took up his quarters in Bannockburn, near Stirling. He marched to attack Hawley, at Falkirk, where Charles won the battle. He stayed two days at Falkirk, and then returned to Bannockburn. Charles began to go north again, as the Duke of Cumberland was in full pursuit. He reached Inverness and turned aside to Moy Castle. There his men rallied round him, and he felt strong enough to attack Loudon, at Inverness, which he accordingly did, and forced him to retire into Ross. Charles laid siege to Fort George and Fort Augustus, and took both of them. He came to a spot five or six miles from Nairn, and stayed in Culloden House. The next day his troops expecting an attack, formed in order on Culloden Plain. No attack being made by the English, the Highlanders marched to attack Cumberland at Nairn, but being too late to make a night attack, they returned to Culloden. Cumberland attacked them, and they were defeated.

Composition.

Write a letter to an Australian Cousin on 'A Parliamentary Election,' *or* The Herring.

Glasgow, 30th June, 1886.

Dear Cousin,

I have now an opportunity of gratifying your desire for some information regarding a parliamentary election in this country, and on account of the momentous question at issue everyone is a politician.

Mr. Gladstone having by the Queen's authority dissolved parliament, writs are issued to the various constituencies to elect representatives to the Imperial Parliament. Accordingly nominations are made by a proposer and seconder seven days before the polling day, and if no opponent is found the member is returned unopposed. However, if the election is contested, the opposing parties work night and day to gain supporters for their candidate. Speeches are made by the candidates or their friends to expound their views and damage the prospects of their opponents. Election literature, cartoons, and every means of showing to mind and eye the goodness of the one cause and the badness of the other are resorted to. Trade is partially suspended, and papers are full of election news and election prospects till the whole gets sickening. On the polling day the voter enters the place appointed for taking votes by ballot, the presiding officer asks the name, sees that it is on the roll or register, marks a counterfoil and hands him a paper on which the names of the candidates are printed. Against the name of his favourite the voter makes a cross, folds the paper, and, having dropped it into the ballot box, withdraws. The poll continues from 8.0 a.m. till 8.0 p.m., when the boxes are sealed and taken to the sheriff, who is returning officer. The ballots are counted, and the majority settles who is to be member. If the contest is very close the defeated candidate may demand a scrutiny of the votes.

The Act called the *Corrupt Practices Act* prevents every species of bribery.

I am, dear Cousin,
Yours affectionately,
ALEX. SCOTT.

Latin.

SECOND STAGE.

(The answers to be written on a separate paper.)

1. Explain the terms deponent, impersonal, neuter passive, as applied to verbs. Illustrate by examples.

2. Latura, vicerint, dic, det, redeuntis. Translate each of these words carefully, parse it, and give the principal parts of the verb to which it belongs.

3. Decline throughout 'Jupiter' and 'mare.'

4. Translate into English the following sentences. :—

(*a*) Quum Cæsar e Gallia exiisset, Labienum legatum creavit.

(*b*) Tempore æstivo dies longiores fient.

5. Translate into Latin:—

(*a*) You have dared to do many things for the sake of your country.

(*b*) When they had finished (conficere, to finish) the journey they rejoiced greatly.

(1) *Deponent* verbs are those which have the inflexions of the passive voice but the meaning of the active, as *hortor*, I exhort; *vereor*, I fear; *utor*, I use.

Impersonal verbs are used only in the third person singular, and can have neither a substantive nor a substantive pronoun as their subject; as *pluit*, it rains; *ningit*, it snows, *grandinat*, it hails.

Neuter passive verbs have an active form in the tenses denoting an imperfect or incompleted action but a passive form with an active meaning in the tenses of a completed action; as *audeo*, I dare, perfect, *ausus sum*, I have dared; *gaudeo*, I rejoice; *soleo*, I am wont; *fido*, I trust.

(2)

WORD.	TRANSLATION.	PARSING.	PRINCIPAL PARTS.
Latura	(the) being about to bear	future part. act.	fero, tuli, latum, ferre.
vicerint	they shall have conquered *or* they may have conquered	3rd pers., plu., fut., perf., ind. *or* 3rd pers., plu., perf.. subj.	vinco, vici, victum, vincĕre.
dic	tell (thou)	2nd pers., sing., imper.	dico, dixi, dictum, dicĕre.
det	let him give *or* he may come	3rd pers., sing., pres., subj.	do, dedi, dătum, dăre.
redeuntis	of the returning person	gen., sing., pres., part.	redeo, redii reditum, redire.

(3)

Jupiter.		Mare.	
Sing.		Sing.	Plural.
N. Jupiter	No plural.	Mare	Maria
G. Jovis		Maris	Marium
D. Jovi		Mari	Maribus
A. Jovem		Mare	Maria
V. Jupiter		Mare	Maria
A. Jove		Mari	Maribus

(4) (*a*) Cæsar having gone out of Gaul made Labienus lieutenant.

(*b*) In the summer time the days will become longer.

(5) (*a*) Multa facere pro patriâ ex ausus.

(*b*) Quum iter confeciŋsent, multùm sunt gavisi.

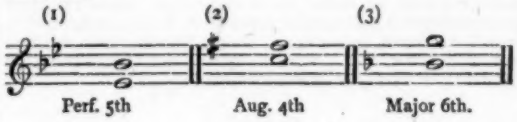
Music.

A quarter of an hour allowed for this Paper.

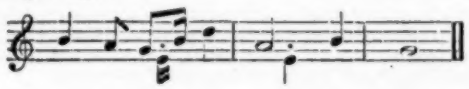
(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa notation will be found at the end.)

STAFF NOTATION.

1. Write below each of the following intervals its name (minor third, &c.):



2. Write below the *dots* in the following the signs for *notes* of corresponding value:



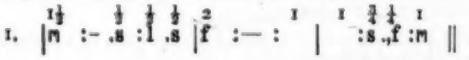
3. Explain (briefly) the meanings of the following terms:—

(1) Ritard. (2) Vivace. (3) Ad libitum. (4) Tempo Primo.

(1) Keeping back. (2) Most animated. (3) Time left to the pleasure of the performer. (4) The first or original time.

TONIC SOL-FA NOTATION.

1. Write in figures over each note and rest in the following passage its value in pulses or fractions of a pulse.



2. In which key will the following passage sound lowest: Key E, B flat, or G?

m s d t_1 r d

2. In the key E, because its doh is lower than either key B flat or key G.

3. State (briefly) the meanings of the following terms:—

(1) Ritard. (2) Vivace. (3) Ad libitum. (4) Tempo Primo.

3. (1) Keeping back. (2) Most animated. (3) Time left to the pleasure of the performer. (4) The first or original time.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year.

FIRST PAPER.

(Two hours and a half allowed for this paper.)

Dictation.

A short passage of prose to be selected by the Inspector, read over once, and then slowly dictated.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word 'Diplomatist.'

Write, in small hand, as a specimen of copy-setting, the sentence 'Dying is but being born anew.'

Arithmetic.

MALES.

1. Divide a profit of £689 among three partners, of whom the first owns $\frac{8}{17}$ of the stock and the second $\frac{5}{13}$.

The 1st gets $\frac{8}{17}$ of £689 or £106. Ans.
The 2nd gets $\frac{5}{13}$ of £689 or £265. Ans.
The 3rd gets $\frac{8}{17}$ of £689 or £318. Ans.

2. A person sells £7,300 out of the 3 per cents. at 96, and invests his money in railway 5 per cent. stock at £106 13s. 4d. How much is his income increased?

$$\text{Income} = \frac{5}{106\frac{2}{3}} = \frac{15}{320} = \frac{3}{64} \text{ of every £}$$
$$\frac{3}{96} = \frac{1}{32} = \frac{2}{64} \text{ of every £}$$
$$\frac{1}{64} \text{ increase of income per £}$$

∴ His income is increased $\frac{1}{64}$ of £7,300 or £114 1s. 3d. Ans.

FEMALES.

1. Find the interest of £220 4s. 7d. for 168 days at 4 per cent.

$$\text{Simple interest} = \frac{£220\,4s.\,7d. \times 168 \times 4}{365 \times 100} = \frac{£44\,0s.\,11d. \times 168}{365 \times 5}$$
$$= \frac{10571d. \times 168}{1825}$$
$$= \frac{1775928d.}{1825}$$
$$= 4865\tfrac{203}{365}d.$$
$$= £4\ 1s.\ 1d.\ \tfrac{203}{365}d. \text{ Ans.}$$

2. At what rate must £273 be lent from 1st January to 27th May to produce £4·914 of interest?

No. of days from 1st January to 27th May = 146

146 da. : 365 da. } :: £4·914 : rate required.
£273 : £100 }

$$\frac{£4{\cdot}914 \times 365 \times 100}{146 \times 273} = \frac{£2457}{546} = £4\tfrac{1}{2}. \text{ Ans.}$$

3. Find the compound interest on £185 for 3 years at 4 per cent. per annum.

$4 = \frac{1}{25}$ of £100.

£185 prin.	for 1st year.
7·4 int.	,, ,,
192·4 prin.	,, 2nd ,,
7·696 int.	,, ,,
200·096 prin.	,, 3rd ,,
8·00384 int.	for 3rd year
208·09984 amt.	at end of 3 yrs.
185	
23·09984 int.	for 3 yrs.
20	
1·9968s.	
12	
11·96160d.	

∴ Comp. Int. = £23 1s. 11·96. Ans.

4. Simplify the expression $1 + \cfrac{1}{2 + \cfrac{1}{3 + \frac{1}{4}}}$

$$1 + \frac{1}{2 + \frac{1}{3 + \frac{1}{4}}} = 1 + \frac{1}{2 + \frac{4}{13}}$$
$$= 1 + \tfrac{13}{30}$$
$$= 1\tfrac{13}{30}. \text{ Ans.}$$

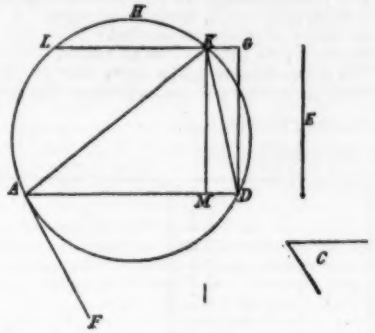
Euclid.

(Book-work, well done, will get the mark 'G.')

1. In every triangle the square on the side opposite an acute angle is equal to the sum of the squares on the other two sides diminished by twice the rectangle contained by either of these sides, and the projection on it of the other side. (Euclid II., 13.)

2. From a given circle to cut off a segment which shall contain an angle equal to a given angle. (Euclid III., 34.)

3. To construct a triangle, having given the base, the vertical angle, and the altitude.



(3) Let C be the given angle, AD the base, and E the altitude. At the point A in AD make the angle DAF = ∠C, and by Euclid III., 33, upon AB describe the segment AHD which shall contain an angle = DAF, that is = C. At the point D erect a perpendicular DG = E, through G draw GKL meeting the circumference in K and L. Then by joining L or K with A and D either △ will fulfil the conditions of the proposition. Join KA, KD, KAD is a triangle having the angle AKD in the alternate segment of the circle = DAF, that is = C the given vertical ∠. AD is the base, and the perpendicular KM let fall from K = GD = E the altitude. Wherefore AKD is the △ required. Q.E.F.

Algebra.

1. Extract the square root of $841a^2 - 986ab + 289b^2$.

$29a$	$841a^2 - 986ab + 289b^2$	$(29a - 17b$. Ans.
	$841a^2$	
$58a - 17b$	$-986ab + 289b^2$	
	$-986ab + 289b^2$	

2. Solve the simultaneous equations—

$$\frac{x}{1\frac{1}{2}} = \frac{y}{1\frac{1}{4}}$$
$$\frac{x - y}{1\frac{1}{2}} = x - 5\tfrac{1}{4}$$

(2) (*a*) $\frac{x}{1\frac{1}{2}} = \frac{y}{1\frac{1}{4}}$; or $\frac{2x}{3} = \frac{4y}{5}$; or $10x - 12y = 0$

(*b*) $\frac{x - y}{1\frac{1}{2}} = x - 5\frac{1}{4}$; or $\frac{3x - 3y}{4} = x - \frac{21}{4}$;

$$\therefore 3x + 3y = 4x - 21$$
$$x + 3y = 21$$
$$\text{or } 10x + 30y = 210$$
$$\text{but (a) } 10x - 12y = 0$$
$$42y = 210$$
$$y = 5. \text{ Ans.}$$
$$\text{Hence } x = 6. \text{ Ans.}$$

3. If a person bought a horse, and, after a time, sold it again for £24, whereby he lost as much per cent. as the horse cost him. Find the price of the horse. Verify both answers.

Let x = prime cost of horse.

By selling it for £24 he lost $\frac{x}{100}$ of x or £$\frac{x^2}{100}$

$$\therefore £x - £\frac{x^2}{100} = £24$$
$$100x - x^2 = 2400$$
Completing Sq. $x^2 - 100x + 2500 = 2500 - 2400 = 100$
Taking root $x - 50 = \pm 10$
$$x = 50 \pm 10$$
$$= £60 \text{ or } £40. \text{ Ans.}$$

Proof.

1st. A loss of 60 per cent. on £60 = $\frac{60}{100}$ of £60
= 36
∴ £60 − 36 = 24. Q. E. D.

2nd. A loss of 40 per cent. on £40 = $\frac{40}{100}$ of 40
= 16
∴ £40 − 16 = 24. Q. E. D.

Grammar.

'Is *life* worth *living*? To the querulous cry
Let this long record, lately *closed*, *reply*.
A *century* of service to mankind!
Pessimist cold and *cynic* blandly *blind*,
'Tis fitter *comment* on *that* query *stale*
Than sneers *that* pale and arguments that *fail*.'

1. Analyse the above passage.

2. Parse the words in italics.

ANALYSIS.

SENTENCES	KIND	SUBJECT	PREDICATE	COMPLETION OF PRED.	EXTENSIONS
(*a*) Is life worth living	Prin.	Life	is worth	living	
(*b*) to the querulous cry let (thou) this long record, lately closed, reply.	Prin.	(thou)	let	this long record lately closed (obj.) (to) reply (complement)	
(*c*) A century of service to mankind! 'tis fitter comment on that query stale	Prin.	it—a century of.....mankind	is fitter comment on that query stale		Pessimist cold and cynic blandly blind (exclamatory phrase)
(*d*) than sneers are (fit comment)	subord. adv. to (*c*)	sneers	are (fit comment)		
(*e*) that pale	subord. adj. to (*d*)	that	pale		
(*f*) and (than) arguments are (fit comment)	subord. adv. to (*c*) co-ord. with (*d*)	arguments	are (fit comment)		
(*g*) that fail	subord. adj. to (*f*)	that	fail		

Parsing.

Life—abstr. noun, neut., sing., nom., subj. of 'is.'

living—gerund of the verb 'to live,' obj., gov. by 'worth,' or obj. of 'value' (we say 'Is it worth a penny?' 'is it worth anything?')

let—irreg. trans. verb, *let, let, let*, imper., 2nd pers., sing., or plur. pres. agr. with sub. (thou) or (you).

closed—past. part. pass. of the reg. trans. verb. 'close' predicative of 'record.'

reply—reg. intrans. verb, infin., pres., gov. by 'let.'

century—abstr. noun, neut., sing., nom., independent.

cynic—com. noun, mas., sing., nom. of address.

blind—adj. predicative of 'cynic.'

comment—abstr. noun, neut., sing., nom. after 'is.'

that—demonstr. adj. dist. 'query.'

stale—adj. predicative of 'query.'

than—conj. subord. of compar. connecting 'sneers are' with ''tis fitter, &c.'

that—simple rel. referring to 'sneers,' 3rd pers., pl., neut., nom. to (are).

fail—reg. intrans. verb, indic., pres., 3rd pers., agr. with 'that.'

3. In what different lights may the verbal 'ing' as a part of speech be regarded? Discuss the subject.

The verbal in 'ing' as a part of speech may be regarded as either a 'participle' or a 'gerund.'

The participle in -ing is present and partakes of the nature both of a verb and of an adjective, as 'Hearing a noise I went to the window,' where 'hearing' qualifies 'I' as well as governs 'noise.'

A gerund on the other hand is a noun formed from a verb by the affix -ing, and when formed from a transitive verb has the governing power of the verb, as, 'He escaped by crossing the river,' where 'crossing' is governed by 'of' as well as governs 'river.' Gerunds may be either subjects or objects, participles are used only as adjuncts.

4. Are there many words derived from the Greek in the above passage? Give, with dates, some account of the introduction of Greek words into our language.

Cynic is the only word derived from the Greek, being from kuon, meaning 'a dog.'

A few Greek words came in with Augustine in the end of the sixth century; but the great movement known as the revival of learning had a most powerful effect on the language. When the Turks took Constantinople in 1453 the learned Greeks of that capital fled, carrying with them their precious manuscripts—copies of Greek and Latin writers. They fled westward to France and England, and taught Greek and Latin in the universities. Very soon the study of Greek and Latin became the fashion. Queen Elizabeth was a good Greek scholar. A great many Greek words have come to us through the Latin, but it is in modern times that Greek has come to the assistance of scientific men by supplying them with terms for inventions and discoveries in all branches of science.

SECOND PAPER.

(*Two hours and a half allowed for Females, and three hours allowed for Males, for this Paper.*)

Geography.

1. Draw a map of Central America, showing the natural features, the political divisions, with the capital of each, and one degree of latitude and longitude.

2. Give a list of the groups of islands lying north of the Equator, and east of Japan and the Philippine Islands. Indicate to which European country (if any) each belongs.

These islands, under the general name of Micronesia, embrace the following principal groups:—The Bonin Isles, S.E. of Japan; the Ladrone or Marianne Isles E. of the Philippines, belong to Spain; the Caroline and Pelew Islets, also termed the New Philippines, N.E. of New Guinea, belong nominally to Spain; the Marshall, or Mulgrave Archipelago, E. of the Caroline Group, consists of several distinct groups of low coral islets; and the Sandwich Islands are situated about 3,000 miles west, S.E. of Mexico, and about the same distance N.E. of New Guinea.

3. What, where, and for what noted are:—New Zealand, San Domingo, Sacramento, Sandwich Islands, and Patagonia.

New Zealand, a colonial possession of Great Britain, consisting of a chain of three large and several smaller islands, is situated in the South Pacific. With the exception of gold and gold-dust, wool is more largely exported than any other commodity. The gum known as 'Kauri gum' forms an important article of export. Ship-building and the trade in timber are, next to mining and wool-growing, the chief industries.

San Domingo, the capital of the Republic Dominica, in Haiti, was the first permanent settlement made by Europeans in America, having been founded in 1502, and is now the oldest existing city in the New World. The bones of Columbus remained in the cathedral of San Domingo till 1795, when they were removed to Havana.

Sacramento, a city of California, on a river of the same name, has an extensive commerce, and is now the chief depôt for the northern mines. The *Sacramento river* rises in the Serra Nevada, flows S. between these mountains and the coast range, and falls into the Bay of San Francisco.

The Sandwich Islands are a group in the N. Pacific, discovered by Captain Cook in 1778. There are eight principal islands and five smaller. They are fertile and abound with the productions of the tropics. The natives are in general of a friendly and mild disposition, and many have been converted to Christianity. The exports are sugar, coffee, rice, wool, and sandal-wood.

Patagonia, an extensive country occupying the southern termination of the American continent, is bounded on the N. by La Plata and Chili, on the W. by the Pacific, on the S. and E. by the Atlantic. The population is estimated at about 30,000. Immense herds of wild cattle and horses roam over its surface. The natives of great stature lead a nomadic life and subsist by hunting and fishing.

History.

1. Give a short account of the origin of the struggle between Charles I. and his Parliament.

The reign of Charles I. was one long struggle for power between him and his Parliament. He dissolved his first Parliament in a fortnight, and levied taxes by his own authority, revived forced loans, and quartered his soldiers in private houses. In 1628, on calling a new Parliament, he was constrained to sign the Petition of Right, but it was soon seen that he did not regard his promise. In 1629, Parliament was again dissolved, and nine members imprisoned. For eleven years he, by the assistance of Strafford and Laud, tyrannized over the nation. In 1637, the levy of ship-money caused the greatest discontent, and Hampden became the champion of the people's rights. Want of money at length forced Charles to call a Parliament in 1640, which beheaded Strafford, and finally brought Laud also to the block. It passed a Grand Remonstrance and printed it for the purpose of informing the nation what Parliament had already done, and what remained for it to do. By the attempted arrest of five members in 1642, all London was aroused, and Charles fled to York. The Commons demanded that he should give up the command, and on his declaring that he would not give up the command for a single hour the Civil War began.

2. What led to the rebellion in Ireland in 1798, and what was the result of it?

During the latter end of the eighteenth century attempts were made to do away with the Irish Parliament, and in the sixth year of the reign of George I. the Irish House of Lords was deprived of its power as a court of appeal, and at the same time the English Parliament was declared to have power to make laws to bind the Irish. The Irish Parliament was filled with persons in the pay of England. A rebellious spirit arose in the country and attacks were made on the English Government in the *Freeman's Journal*. Secret societies were formed in large numbers, and sedition was rampant. Grattan worked for legislative independence, and when the American War broke out, assisted by a Convention of volunteers, he managed to get the Act of the reign of George I. repealed. Differences now arose among the leaders, and some more hostile than others determined to fight for freedom. The principal leaders were Edward Fitzgerald, Tone, and O'Connor. Tone obtained the assistance of a French fleet which was destroyed by bad weather. After this rebellion was suppressed by great cruelty, Pitt was convinced that the time was now ripe for a union between the two Parliaments. The landholders offered great opposition, and more than a million was spent in buying them over, and by a lavish bestowal of honours. An effective majority was thus secured, and the Parliament of Ireland was incorporated with that of England, 1801.

Composition.

Write an essay on 'Colonies,' or on the 'Discovery of America.'

Colonies.—The planting of colonies is amongst the earliest occurrences recorded in history, Phœnicia, Greece, and Rome being all famous for their colonies.

The establishment of colonies by European nations during the sixteenth century was one of the most important events in the history of the world. Immediately that interest was excited by the discoveries of Columbus a desire to acquire new territories took hold on the minds of several European nations, and on the English amongst the rest. It would appear that the Anglo-Saxon race is the only one that is able to colonise successfully on a large scale. Of European nations besides the English, that formerly possessed a large colonial empire, the Dutch have retained more than any other.

Colonization has owed its increase to the difficulty of men to find employment at home, to low wages, and to scarcity of food. Beyond the sea lands of great fertility were lying unused, and by bringing the idle people and the untilled lands together a great evil has been redressed.

For a time colonization fell into discredit by the custom of sending criminals to the newly-acquired possessions, because honest people refused to take up their abode with men who had committed serious crimes. In course of years the practice of sending convicts was stopped and thenceforward immigration into our colonies increased immensely.

The kinds of people most in demand for the colonies are farm-labourers of all sorts, skilled artisans, and domestic servants. To meet the great demand for these, our government has assisted and even given free passages to properly qualified persons. Free grants of land have been given to those who have paid their own passage out.

The advantages conferred by the colonies on the mother country are great, and one of the most valuable is that they furnish a new home for thousands who find it a difficult matter to gain a livelihood in their own country.

Latin

(THIRD STAGE.)

(The answers to be written on a separate paper.)

1. Translate into English:—

Tum demum Ariovistus partem suarum copiarum quae *castra* minora *oppugnaret* misit. Acriter utrimque usque ad vesperum pugnatum est. Solis occasu suas copias Ariovistus multis et *illatis* et acceptis vulneribus in castra reduxit. Cum ex captivis quaereret Caesar quam ob rem Ariovistus praelio non decertaret, hanc reperiebat causam, quod apud Germanos ea consuetudo esset ut matres familiae eorum sortibus et vaticinationibus declararent, utrum proelium committi ex usu esset, necne: eas ita dicere; non esse *fas* Germanos superare, si ante novam lunam praelio *contendissent*.

2. Parse the words in *italics* in the above passage.

3. Illustrate by example the various uses of the ablative case in Latin.

4. Translate into Latin:—

(*a*) He commanded these to learn what Ariovistus said.

(*b*) Very many treaties had been broken by the Gauls; the Romans had often fought with them.

(*c*) Our country must be defended by all good citizens.

Translation.

Then at length Ariovistus despatched a part of his forces to storm the lesser camp. The fight was maintained vigorously on both sides until evening. With the setting of the sun, Ariovistus after many wounds were given and received led back his forces into camp. When Caesar inquired of the prisoners why Ariovistus would not engage in battle he discovered this to be the reason—that among the Germans this custom obtained that the matrons should declare from lots and auguries, whether a battle should be fought advantageously or not; that these (women) spoke as follows—that it was not the divine will that they should conquer if they engaged in battle before the new moon.

Parsing.

Castra—acc., pl., neut., of a noun of 2nd decl., custrum-i-a, fort, in the plur., a 'camp,' gov. by 'oppugnarent.'

oppugnaret—trans. verb, 1st conj., *oppugno-avi-atum-are*, subj., imperf., 3rd per., sing., agr. with 'quae.'

illatis—irreg. trans., 3rd conj., *infero-intuli-illatum-inferre*, perf. part., pass., neut., pl., abl., absolute with 'vulneribus.'

fas—abstr. noun, indeclinable, neut., obj., accus., before 'esse.'

contendissent—trans. verb, 3rd conj. *contendo-tendi-tentum-tendere*, subj., pluperf., 3rd pers., pl., agr. with (illi Germani).

3. Ablative of separation '*Solvere aliquem legibus*'; to exempt any one from the laws.
Ablative of origin, *Jove natus*; born of Jupiter.
Ablative of cause, manner, and instrument, *palleo metu*, I am pale from fear, *fecit suo more*, he did it after his own way.
Ablative of time; *vere*, in spring, *aestate*, in summer.
Ablative of place (where); *loco parentis*, in the place of a parent, *meliore loco*, in a better place.
Ablative of quality; *flumen difficile transitu*, a river difficult to cross.
Ablative after comparatives; *dulcior melle*, sweeter than honey.
Ablative of place (from); *proficiscitur Roma*, he starts from Rome.
Ablative after *utor*, *abutor*, *vescor*, &c., *utitur fraude*, he uses fraud.

4. (*a*) Hos jussit reperire quid Ariovistus dixisset.
(*b*) Plurima foedera a Gallis violata erant, Romani sæpe cum iis contenderant.
(*c*) Patria omnibus civibus bonis est defendenda.

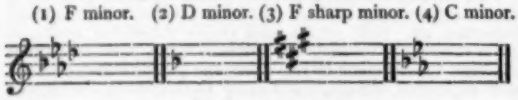
Music.

A quarter of an hour allowed for this Paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Natation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa notation will be found at the end.)

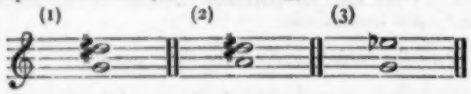
STAFF NOTATION.

1. Write the signatures of the following *minor* keys:
(1) F minor. (2) D minor. (3) F sharp minor. (4) C minor.

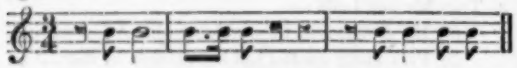


2. Write above (1) an augmented fifth, above (2) an augmented (pluperfect or tritone) fourth, above (3) a minor sixth.

(1) (2) (3)



3. Add bars to the following in accordance with the time-signature:



TONIC SOL-FA NOTATION.

A quarter of an hour allowed for this Paper.

1. Write (1) above *soh* an augmented fifth, (2) above *ray* an augmented (pluperfect or tritone) fourth, and (3) above te_1, a major sixth.

2. What is the name (1) of *soh* sharp, (2) of *lah* flat, (3) of *doh* sharp?

3. Re-write the following, doubling the value of every note and rest. Use four-pulse measure.

| s ,,l :s . | m .f,s : .d |

1. (1) Re. (2) Se. (3) Se.

2. (1) Se. (2) La (lay.) (3) De.

3. | s :- .l | s : | m :f .s | :d |

Note to Pupil Teachers' Examination Questions, with Answers.

A Lady Correspondent calls our attention to what she terms 'a very absurd mistake' in the paraphrase of an extract from Scott's 'Marmion.' A reference to the context of the passage shows at once that 'dark designs' should be altered to some such words as 'remorseful reflections.' It cannot, however, be presumed that pupil teachers or other examinees will be acquainted with the context of any isolated passage they may have to paraphrase unless they have had to study the work previously. The writer of the paraphrase in question wrote without reference to, or recollection of, the context of the passage in 'Marmion.' We beg to thank our Correspondent for the interest she has shown in pointing out an accidental mis-interpretation, the excuse for which we have stated.

The Result of the Pupil Teachers' Prize Competition will be announced in our next issue.

—o—

The Nääs Slöjd.

BY MISS J. WARREN,

Inspectress of Infant Schools to the Leicester Board.

My object this month is to put before my readers, as clearly as I can without pictorial illustration, a list and description of the articles in wood made by us in the course we pursued. I have said in a former paper that the work was followed from the actual article itself, and not from plan or description. In a work-room, with about twenty of us at our benches, some three or four of each kind of article would be distributed; first we were told to examine it, and talked of the wood used, next the size piece to select, and finally the operation began. The first model made in the Nääs Slöjd is a *penholder*. This, as will be imagined, was very simple, being merely a piece of birchwood shaved into shape with the Slöjd knife, and afterwards polished smooth with sand-paper and shavings. The holder measures about six inches, and is about one-half inch in diameter at its pen end, tapering gradually off until, at its further end, it measures about one-eighth of an inch in diameter. The only tools used for this model are the *saw* and the *knife*, the former to sever the right length of wood, and the latter to shave the wood into the proper shape; the time taken in making is from two to three hours, and even with the knife, care will bring it to a high state of finish. This holder, I may add, as it leaves the hand of the workman, is not quite ready for use; the slot for the pen must be made, and I do not remember what explanation was given us for this operation not being performed—probably its difficulty—for I do remember making the same article a second time, and having to bore the hole for the insertion of a pen. *The first model* is also used as a 'blomsterpinne,' or, as we in England have it, a *flower stick*. It must be noticed by those who are trying to follow this course through, that the saw is very little used in the first model, that implement needing dexterous handling; but in no model is it entirely left out, so that constant practice with a very necessary, though difficult, tool, makes up for lengthened use; indeed, I doubt much whether any other training than the very excellent one in Nääs would ever have enabled us to overcome its difficulties; by their plans we had, in a great measure, mastered it before we really knew of all its many drawbacks. The knife used is identical with the Norwegian knife sold in many tool shops in

London. I have one before me as I write; the handle is about three inches, and the blade four inches long. The operation known amongst our schoolboys here as *whittling* with the knife is the process by which the model is brought to perfection, and not unwisely has the knife been chosen to precede all other tools in the Slöjd. Very much care was bestowed upon each pupil for its right handling, the working mostly being downwards, and with a free use of the left thumb as leverage. The reverse operation was made safe by a use of the third left-hand finger. The muscles of the hand joints, it will be seen, are by this tool gradually strengthened and made fit to grasp steadily and firmly any larger tool requiring not only finger, but arm movements too.

The second model is a flower stick, two or three inches longer than the first, and differing from it in having four plane surfaces instead of one curved face. The tools are the same, but the wood differs, being a hard fir—very plentiful in Sweden. This model needs very little more care than the first, the knife, being much used, is now becoming more tractable to the pupil, and can be used with fewer false attempts or failures. The same time accomplishes the work, and two days therefore sees the completion of two useful articles, both of which find their way into the home of the little workman.

The third model is another *penholder*, but in this the hole is bored for a pen; and, save for this and a different wood being used, is in all points similar to the first. We are told that repetition is an important factor in education. Now at Nääs they managed to dress our old enemy up so nicely, and introduce him at such opportune times, that we felt, not only not sorry, but really glad to make his acquaintance. I asked of the Director, once, 'Why do you not have several of each model made, until one is perfect enough to retain?' 'This,' said he, 'would be entirely contrary to the spirit of Slöjd; we seek to make our children desire work. To do as you say would tire them, and no work is good that does not engage the child's whole heart, as well as his hands.'

The fourth model, a flower stand, is made of fir wood, and, in addition to the other tools, the plane is used. This model is made in two pieces, exactly alike, and by an ingenious contrivance these fit on to each other, forming a cross-shaped foot, upon which can be placed an ordinary flower pot. The whole thing is very small, but I can well see how delighted a child would be to complete such an article. For my own part, I looked and looked and 'still the wonder grew' that so compact a thing was the result of my own handiwork. The plane, please notice, is here introduced—I refer to the small hand plane—the wood in the other surfaces had been smoothed with a knife. Now we are required to handle the plane proper; the left-hand position is very carefully shown, and great steadiness is exacted. We had, in all, four planes to use during our course, each requiring special skill; this number does not include the charming little American tool of the same name, constantly in use at Nääs.

I should like to call attention to the uses of these first four models. The school and home are well represented. The pen shares with home articles a first position. This arrangement, I have reason to believe, is not accidental. Again, with regard to flower stand and support, the simple-hearted, nature-loving Swedes adore flowers. No opportunity is ever passed over when they can, by a gift of flowers, speak their love and friendship. It is a regular national parting gift—the bouquet—and it would seem that the love is universal. The peasant homes are therefore kept well supplied with stands, for the greater health and cleanliness of the window plants.

The fifth model is a *clothes peg*; this is very similar to that in England, but made in one, instead of two pieces, and complete in wood only. A file is used, in addition to all the other tools, and its use seemed to pervade the whole of the rest of the work. So much can be accomplished with it that I think no house should be without it. Birch wood is used in this model, and occurs pretty frequently throughout the series.

The sixth model is a paper knife, of ordinary length; made of the native birch. A different saw is introduced in this model; the Swedish name is 'rundsåg,' later on our own term may occur to me, just now I do not remember it. The slope of the blade is made almost entirely with a Slöjd knife; and, although the paper knife is of the plainest possible shape, devoid of ornamentation, still we found it a little difficult to manipulate the wood with enough success to produce a decent blade. Though so simple, my readers will agree with me it is a very useful article, and might be retained in any scheme of Slöjd introduced here. I have used mine constantly for nearly two years and, beyond being a little dirty, is as good as when I first set it up.

The seventh model, a butter spade, requires no new tools; the two saws, 'rundsåg' and 'sinksåg,' are used freely. The finishing up is done with file, scraper and sand-paper. The article is about the size and shape of a small cheese cutter, and is used to mould the butter for table use.

Elsewhere I have explained that no polish or varnish is used in the Nääs Slöjd, all finish is done by such tools as file, scraper, sand-paper, &c., but we constantly effected a very satisfactory finish by using the shavings, and I am obliged to confess that we did not always seek for these under our own benches. There were one or two male students, notably those of Russia, who made delightful shavings—they seemed to have quite a gift that way. This finishing off is splendid exercise for the arms, for it needs to be both rapid and continuous to do any good. The scraper I have hitherto omitted to mention in detail, but I think it is very well known in England; a simple band of steel, differing curiously enough from an ordinary blade, being useful only when the edge is turned; it is used to take off small rough pieces of wood left after a file. We used in the making of all the models, after the first two, a set square, called in Sweden 'vinkel;' and, in the first marking, a blacklead. The axe, so constantly in use later on, is not introduced into these first models, because of its weight and size; but some of the Slöjd children were very clever in its use, and when passing round from school to school we were invited to compete with the youngest pupils in a trial with it, together with the saw and plane.

I close my paper this month with the seventh rule, and I hope, before finishing, to insert a picture of these models, though at present I experience some difficulty in getting them copied.

(To be continued.)

Query Column.

RULES.

1. Each correspondent is restricted to *one question*. We should be much obliged if correspondents, who send questions for solution, would give (if possible) the required answer, and the source from which the question is obtained.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. ☞ When a pseudonym is adopted it should be written at the end of the query, and the real name and address on a separate piece of paper.

4. Correspondents are requested to write their queries *legibly*, and on one side of the paper only.

5. Replies will not be sent through the post.

6. Queries must reach the office *not later than the 12th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed—'*The Query Editor*,' *The Practical Teacher*, *Pilgrim Street, Ludgate Hill, London, E.C.*

General.

1. STUPIDITY.—The solution of your query appeared in our *last* issue.

2. BRIANNICK.—You will find an extensive list of books on the subject in the syllabus itself. To add to that would be to gild refined gold. If you merely want a few good books valuable in themselves and to the point, take *Sully's* recent volume on 'Education' (Longman and Co.), advertised in our last number; also read *Fitch's* 'Lectures on Education,' and *London's* 'School Management' (Kegal Paul). You can study the notes of lessons which have lately appeared in *The Practical Teacher*.

3. SEMPER EADEM.—The book is excellently bound and printed. It is dear. You do not say what you want it for. Our criticisms may therefore be wide of the mark. We can, however, recommend the book strongly and without reserve. It is a great advance on the old text books, and likely to have a wide circulation. We do not see how you could possibly do wrong to get it, study it, use the methods adopted in it, and be ready for a better when it appears. In this subject 'Night's candles are gone out and jocund day stands tiptoe on the misty mountain's brow.'

4. HAMLET.—We hope you are only experimenting upon us. You don't intend to write at the certificate examination like the specimen you sent to us. We don't mean to say that certificates will be refused to those who write worse. Unfortunately some officials write a hand that takes two people to read. Early in this year a circular was used pointing out the most obvious faults in the penmanship exercise at the last certificate examination. It is ungrateful to go on as though that had not been published. Read it and practise some good models—large hand, 45; small hand, 55.

5. EXCELSIOR.—First of all buy a '*Code*' and read the sections relating to the certification of teachers, and then buy the syllabus and questions set at the last Christmas examination. You will find in these all the information you want. They only cost a few pence; order them through any bookseller.

6. ST. GILES.—We cannot tell you exactly; something might depend on the kind of mistake. But you need not be apprehensive if the number is not greater than the one you state.

7. VOLTAIRE.—1. Most likely not. We know why you ask; take our advice and continue your studies this autumn; you will not regret it. It is most likely that all pupil teachers will ere long be required to take the examination you have in view. 2. Very shortly. 3. We do not know. You could find out by writing to the secretary of the college. The list of marks for the separate subjects is not published. If you have any spare time pay attention to your writing.

8. W. POTTER.—At present they are not allowed, but they possibly may be in years to come. We cannot say. You can draw one by free hand as well as you can, or you can use a coin.

9. E.H.S.—*Findlater's* 'Physiography' would suit you very well; add *Huxley's* if you can; above all, observe and think for yourself.

10. SEWIG.—The motion of the water. Study one on a small scale by observing the water in a drain, or on a sink, or in a river. Currents meet at different angles and with different speeds, and the results will depend upon the special circumstances. Often an eddy is thus formed.

11. STEPHONIANO.—You cannot sit for a certificate; see Code, Art. 57. You should have either completed your apprenticeship, or passed the examination for admission into a training college. You had better find a situation where you could complete your apprenticeship. You could then become provisionally certificated, and, after a favourable report from your inspector, you could be examined for a certificate; or you could apply next year to be admitted into a training college, and obtain your certificate in the usual way; lastly, you could apply to sit for the scholarship examination without afterwards entering a training college, and then obtain your certificate subsequently.

12. HOPEFUL.—We are glad to help you. Try *Rick's* 'Object Lessons.' Any simple Manual on Physiology will suit you for the second purpose. You could not have a better guide than 'The Revelation,' New Testament Commentary (Cassell and Co.), 3s.

13. A. J. ROBERTS.—We don't know of any separate maps at the prices you mention. There are maps in the best school editions of the authors you name, and if that is what you want you must say so. But you cannot get them at the price stated.

14. A.H.M.—There are two or three expensive books you could buy. 'Elements of Comparative Anatomy,' by *Gegenbaur* (Macmillan, 21s.). We doubt if you could do better than use *Huxley's* 'Invertebrata.' Write for the latest regulations. They will be sent post free. There have been considerable changes lately. Have you not given the wrong date. We could not verify your reference to the calendar. You also wrote muscle; did you mean mussel? muscle has always been included amonst the tissues.

15. SEVILLE.—*Deschanel's* 'Natural Philosophy,' last edition, Parts 2, 3, and 4. You could also consult 'Heat,' by *B. Stewart*, 'Heat and Light,' by *Tait*, 'Electricity,' by *S. Thompson*, and for actual work *Worthington's* 'Laboratory Practice' or *Glazebrook's* 'Practical Physics.' Possibly the first book mentioned will contain all you want.

16. R.—Apply to the registrar, London University, Piccadilly, W. The fees amount to £12 altogether. No list of marks for separate questions has ever been published. You won't be able to find out; but your own judgment will be a pretty safe guide.

17. STUDENT.—(1) Add *Gegenbaur's* 'Comparative Anatomy.' (2) *Thome's* 'Botany.' (3) 'Geology,' by *Jukes-Brown*. All these subjects should be worked at practically to be of any real service. For that purpose use 'Practical Physiology,' by *Foster* and *Langley*, and 'Practical Botany,' by *Bower* (Macmillan).

18. F. WILKINSON.—You do not give your present status. But whatever that may be you cannot take the branches in consecutive years. There must be a clear interval of two years between them. You should write to your inspector at once, and get his consent. Ask him to tell you if you can sit at Christmas. While you are doing so, enquire what centre will be nearest your residence.

19. X.Y.Z.—Large hand; letters too large and too upright, and of imperfect shapes. You would soon write a good hand if you would practise; try to imitate really good models. Do this for a while and let us see the result. Large hand, 50; small hand, 60.

20. STUDENT.—Caryatids, from Caryates-atides, figures of women dressed in long robes. These bore up or supported other figures of an emblematic kind. The *valves* were open spaces, in some parts of which there were figures of hunters who were represented as paying dear for entering forbidden ground. *Bell mouthed* has reference to the shape of the mouth—that of a bell. *Rapt*, is snatched or torn away and carried down the stream. *Glow to gloom* denotes the change of scene from one of joy to one of dismay. *Musky-circled* mazes means mazes encircled with fragrant flowers. *Mnemosyne* was the goddess of memory, here a statue of her.

Algebra.

1. WIDMORE.—If £ P at compound interest, rate r, double itself in n years, and at rate $2r$ in m years, show that $m : n$ is greater than 1 : 2. *(Hamblin Smith.)*

$$\left.\begin{array}{l}(1)\ 2\,P = P(1+r)^n \\ (2)\ 2\,P = P(1+2r)^m\end{array}\right\}$$

$$\therefore (1+r)^n = (1+2^r)^m;$$

$$(1+r)^2 = (1+2r+r^2),$$

$$(1+r) = (1+2r+r^2)^{\frac{1}{2}}$$

$$(1+r)^n = (1+2r+r^2)^{\frac{n}{2}};$$

$$\therefore (1+2r)^m = (1+2r+r^2)^{\frac{n}{2}},$$

Wherefore, $m > \frac{n}{2}$,

$$2m > n,$$

$$\therefore \underline{m : n > 1 : 2.}\quad \text{Ans.}$$

2. PRECEPTRESS.—Solve :—

$$\left.\begin{array}{l}\frac{1}{x}+\frac{3}{y}=\frac{3}{2} \\ \frac{3}{x}+\frac{7}{y}=\frac{23}{6}\end{array}\right\}\ (\textit{Certificate}, 1881.)$$

$$\left.\begin{array}{l}(1)\ \frac{1}{x}+\frac{3}{y}=\frac{3}{2} \\ (2)\ \frac{3}{x}+\frac{7}{y}=\frac{23}{6}\end{array}\right\}$$

$$\left.\begin{array}{l}(1)\times 3\ \frac{3}{x}+\frac{9}{y}=\frac{9}{2} \\ (2)\ \frac{3}{x}+\frac{7}{y}=\frac{23}{6}\end{array}\right\}$$

$$\text{Subtracting}\left\{\begin{array}{l}\frac{2}{y}=\frac{2}{3} \\ \frac{1}{y}=\frac{1}{3} \\ \therefore \underline{y=3}\end{array}\right.$$

$$(1)\ \frac{1}{x}+\frac{3}{3}=\frac{3}{2}$$

$$\frac{1}{x}=\frac{3}{2}-1$$

$$=\tfrac{1}{2}$$

$$\therefore \underline{x=2}$$

$$\therefore \underline{x=2 \text{ and } y=3.}$$

3. W. POTTER.—Given log. 2 = ·301030 and log. 3 = ·477121, find the logarithms of 36, 27, and 16. *(Todhunter.)*

Log. 36 = log. (4 × 9)
= log. ($2^2 \times 3^2$)
= 2 log.^{3} + 2 log.^{3}
= (·301030 × 2) + (·477121 × 2)
= ·602060 + ·954242
= 1·556302. Ans.

Log. 27 = log. 3^3
= 3 log 3
= ·477121 × 3
= 1·431363. Ans.

Log. 16 = log. 2^4
= 4 log. 2
= ·301030 × 4
= 1·204120. Ans.

4. PRECEPTRESS.—Solve :—

$$\left.\begin{array}{l}x^2-y^2=75 \\ xy=154\end{array}\right\}\ (\textit{Certificate}, 1881.)$$

$$\left.\begin{array}{l}(1)\ x^2-y^2=75 \\ (2)\ xy=154\end{array}\right\}$$

$$(2)\quad y=\frac{154}{x};$$

$$(1)\ x^2-\left(\frac{154}{x}\right)^2=75$$

$$x^2-\frac{23716}{x^2}=75$$

$$x^4-75x^2=23716$$

$$x^4-75x^2+(\tfrac{75}{2})^2=23716+\tfrac{5625}{4}$$

$$=\frac{94864+5625}{4}$$

$$=\tfrac{100489}{4}$$

$$x^2-\tfrac{75}{2}=\pm\tfrac{317}{2}$$

$$x^2=+\tfrac{317}{2}+\tfrac{75}{2}$$

$$=196, \text{ or } -121$$

$$\therefore x=\pm 14.$$

$$(2)\quad y=\frac{154}{x}$$

$$=\frac{154}{\pm 14}$$

$$=\pm 11.$$

$$\therefore x=\pm 14 \text{ and } y=\pm 11.$$

5. ACTING TEACHER.—Write down the first three terms and the $(r+1)^{\text{th}}$ term of the expansion $(1+x)^{\frac{m}{n}}$.

If p be the integral part of the fraction $\frac{m}{n}$, prove that the first $p+1$ terms of the expansion are positive, and that the succeeding terms are alternately negative and positive.

(a) The first three terms of $(1+x)^{\frac{m}{n}}$

$$=1+\frac{m}{n}x+\frac{\frac{m}{n}\left(\frac{m}{n}-1\right)}{1.2}x^2$$

(b) The $(r+1)^{\text{th}}$ term of $(1+x)^{\frac{m}{n}}$

$$=\frac{\frac{m}{n}\left(\frac{m}{n}-1\right)\left(\frac{m}{n}-2\right)\cdots\left\{\frac{m}{n}-(r-1)\right\}}{\lfloor r}x^r$$

$$=\frac{m(m-n)(m-2n)\cdots[m-n(r-1)]}{n^r\,\lfloor r}x^r$$

(c) From *(a)* it will be seen that the terms are positive until $\frac{m}{n}$ does not exceed the number to be subtracted.

Thus, if $\frac{m}{n}=p$ (whole number) $+\frac{q}{n}$ (proper fraction), the terms will be positive until the $(p+1)^{\text{th}}$ term; the next term will be negative, and the next positive, as two negative quantities multiplied together give a positive result.

∴ After the $(p+1)^{\text{th}}$ term the succeeding terms are alternately negative and positive.

6. DISCIPULUS.—At what rate of Compound Interest would a sum of money be doubled in 16 years? *(Edinburgh Matriculation.)*

Let R denote the amount of one pound in one year, P the principal, A the amount, and n the number of years.

Then, $A = PR^n$;

$$2P = PR^{16},$$

$$2 = R^{16},$$

$$\therefore R = 2^{\frac{1}{16}}$$

$$\log R = \frac{\log 2}{16}$$

$$=\frac{\cdot 30103}{16}$$

$$=\cdot 018814375,$$

$$\therefore R = 1\cdot 0442\ldots\ldots$$

Amount of £100 in one year = 104·42……

∴ Rate per cent. = 4½ (nearly).

7. DISCIPULUS.—If £98 were accepted as present payment of £128, due some time hence, what sum should be the proper discount off a bill of £128, which has only half the time to run—compound interest? (*Edinburgh Matriculation.*)

Let P denote the present value in pounds, A the amount, R the amount of one pound in one year, and n the number of years.

Then, $A = PR^n$;

$\therefore 128 = 98\ R^n$

$R^n = \frac{128}{98}$

$= \frac{64}{49}$;

In the second case,

$128 = P\ (R^n)^{\frac{1}{2}}$

$= P\ (\frac{64}{49})^{\frac{1}{2}}$

$= P \times \frac{8}{7}$,

$\therefore P = 128 \times \frac{7}{8}$

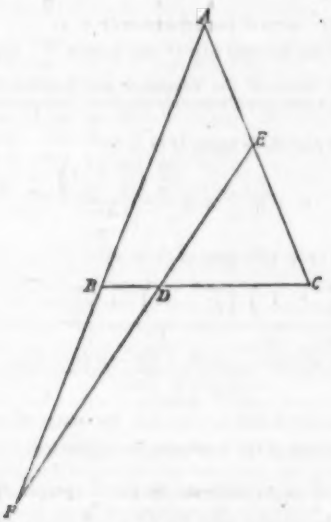
$= 112$;

$\therefore$ Discount = £128 − £112

= £16. Ans.

Geometry.

1. E. JONES.—In the base BC of an isosceles triangle take any point D; in CA make CE = CD, and let ED cut AB produced in F. Then will three times the angle AEF be greater than four right angles by the angle AFE. (*Pupil Teachers' Examination*, March, 1881.)



Proof.—∠AEF = ∠ECD + ∠CDE (I. 32)

$\therefore$ 3 times ∠AEF = 3 times ∠ECD + 3 times ∠CDE

= Twice ∠ECD + ∠ABC + twice ∠CED + ∠CDE (I. 5)

= Twice ∠ECD + ∠BDF + ∠BFD + twice ∠CED + ∠CDE

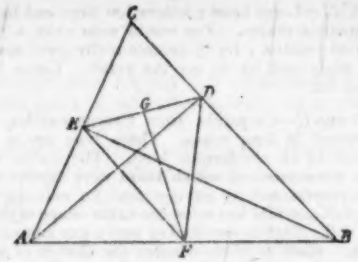
= Twice ∠ECD + twice ∠CDE + twice ∠CED + ∠AFE

= Twice (∠ECD + ∠CDE + ∠CED) + ∠AFE

= (Two right angles × 2) + ∠AFE (I. 32)

= 4 right angles + ∠AFE. Q.E.D.

2. ULYSSES.—From the angles at the base of a triangle, perpendiculars are drawn to the opposite sides, produced if necessary; shew that the straight line joining the points of intersection will be bisected by a perpendicular drawn to it from the middle point of the base. (*Tedhunter.*)



Let ABC be a triangle; from A draw AD perpendicular to BC, and from B draw BE perpendicular to AC. Join ED, and from F, the middle point of AB, draw FG perpendicular to ED. Then ED shall be bisected by FG. Join FE, FD.

Proof.—△ AEB is right angled, and AB is the hypotenuse; From F the middle point of the hypotenuse, a straight line FE is drawn to the right angle;

$\therefore$ FE = ½ AB;

also FD = ½ AB;

$\therefore$ FE = FD.

Because FE = FD,

$\therefore$ ∠FEG = ∠FDG (I. 5)

And right angle FGE = right angle FGD.

$\therefore$ △FEG = △FDG in all respects (I. 26);

Wherefore EG = DG. Q.E.D.

Mensuration.

1. FOLKESTONIAN.—The length of a hall is 3 times the breadth: the cost of whitewashing the ceiling at 5½d. per sq. yd. is £4 12s. 7·1d., and the cost of papering the four walls at 1s. 9d. per sq. yd. is £35, find the height of the wall.

Area of ceiling = (£4 12s. 7·1d. ÷ 5½d.) sq. yds.

= (1090·0d. ÷ 5½d.) sq. yds.

$= \left(\frac{10900}{9} \times \frac{3}{16}\right)$ sq. yds. (625)

$= 21\frac{13}{24}$ sq. yds.;

Area of hall = length × breadth

= 3 times breadth × breadth

= 3 times square of breadth;

$\therefore$ 3 times square of breadth = $21\frac{13}{24}$ sq. yds.,

Square of breadth = $\frac{21\frac{13}{24}}{3}$ sq. yds.,

$\therefore$ Breadth = $\sqrt{8\frac{13}{24}}$ sq. yds.

= $2\frac{13}{24}$ yds.;

And length = 25 yds.

Area of walls = (£35 ÷ 1s. 9d.) sq. yds.

= (700s. ÷ 1¾s.) sq. yds.

= 400 sq. yds.;

Perimeter of hall = (length + breadth) × 2

= $(25 + 2\frac{13}{24})$ yds. × 2

= $\frac{100}{4}$ yds. × 2

= $\frac{200}{4}$ yds.

Area of walls = Perimeter × Height;

$\therefore \frac{200}{4}$ yds. × height of walls = 400 sq. yds.,

$\therefore$ Height of walls = 400 sq. yds. ÷ $\frac{200}{4}$ yds.

= 6 yds. Ans.

Arithmetic.

1. REGULAR SUBSCRIBER.—A person has £2,950 in the 3 per cents. at 83½; when the funds have fallen 2½ per cent., he transfers his capital into the 5 per cents. at 108; find the alteration in his income. (*Barnard Smith*).

Income in 1st case = 3% on £2950

= £29 10s. × 3

= £88 10s.;

Stock in 2nd case = £2950 × $\frac{83\frac{1}{2} - 2\frac{1}{2}}{108}$

= £2950 × $\frac{81}{108}$

= £2950 × ¾

= £2212 10s.;

Income in 2nd case = 5% on £2212 10s.

= £110 12s. 6d.;

$\therefore$ Alteration in income = £110 12s. 6d. − £88 10s.

= £22 2s. 6d. increase. Ans.

2. PERPLEXED.—A and B go to bed at the same hour daily, but A rises at a quarter past 6, and B at 8; how much more of waking life will A have had more than B in 40 years, paying attention to the leap-years? (*Colenso*).

Time = $(8 - 6\frac{1}{4})$ hrs. × $[(365 \times 40) + 10]$
= $1\frac{3}{4}$ hrs. × 14,610
= 25,567½ hrs.
= 1,065 days 7½ hrs.
= 2 years 335 days 7½ hrs. Ans.

3. HANNIBAL.—The excess of the present value of a sum due in one year, reckoning interest at 5 per cent. over the present value when interest is 6 per cent., is 10s. Find the sum. (*Preliminary Paper, Institute of Bankers*, 1882.)

Present value of £100 in 1st case = $£100 \times \frac{100}{105}$
= $£100 \times \frac{20}{21}$
= $£\frac{2000}{21}$;

Present value of £100 in 2nd case = $£100 \times \frac{100}{106}$
= $£100 \times \frac{50}{53}$
= $£\frac{5000}{53}$;

Difference between the present values = $£\frac{2000}{21} - £\frac{5000}{53}$
= $£\frac{106000 - 105000}{1113}$
= $£\frac{1000}{1113}$;

$\therefore £\frac{1000}{1113} : £\frac{1}{2} :: £100 : \text{sum}.$

Sum = $£\frac{100 \times 1113}{2 \times 1000}$
= $£\frac{1113}{20}$
= £55 13s. Ans.

Science Notes.

THE use of naphthalin instead of camphor as a preservative against moths, is becoming general in Germany. It would be obviously inconvenient to sprinkle the white powder over articles of clothing, and a sort of paper is therefore made which contains about half its weight of naphthalin. The leaves can then be put in drawers and boxes, just as pieces of camphor are used at present. This is another valuable purpose to which this once useless bye-product of gas manufacture can be put.

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MR. FLETCHER, who is so well known in connection with the application of gas for heating purposes, has just read a most interesting and instructive paper on what he calls flame contact, a new departure in water heating. His object is to show that water may be boiled by gas much more economically than at present. He points out that the under-surface of the kettle is never really in contact with the flame beneath it, as may be proved by pasting a paper label upon it. He proposes to put a number of copper rods into the bottom of the vessel and let them hang down so as to pass into the flame. The other ends of them pass into the water and are flattened out. The lower ends not being in close contact with the water, can and do attain a sufficiently high temperature to admit of direct contact with the flame and become much hotter than the bottom of an ordinary kettle. The result is that water can be boiled much more quickly and therefore with much less expenditure of gas. If Mr. Fletcher succeeds in making a kettle which will allow water to be heated by gas for domestic purposes economically, he will have given an additional facility for the abatement of smoke in large towns. Mr. Fletcher's reputation warrants us in believing that he will succeed.

MOST valuable papers have recently been compiled by Mr. Giffen, on the position and prospects of those who earn their living by manual labour. These have been brought before the Statistical Society, and published in their proceedings. Professor L. Levi's papers on the same subject have been published in the form of a small volume. The improvement during the last half century in the condition of the artizan has been one of the most striking features of the age. Indeed, Mr. Giffen points out that it can hardly be described as an improvement; it is rather a revolution of a most remarkable kind. But the standard of comfort needs to be raised much higher. Self-reliance and self-denial are the surest and the only means of effecting permanent improvement. Nor must the present low range of prices be overlooked: it is not money, but money's worth that really benefits the artizan.

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THE recent change in conducting the honours examination in botany, at South Kensington, took some of the candidates by surprise. This could hardly be otherwise. Some expected an examination of fresh British flowering plants; others, such work as they were most familiar with, and therefore considered most important. All, however, will doubtless agree that the change is altogether an improvement—a decided step in the right direction. Students in practical botany cannot now complain that the professors have neglected them. Books of the most excellent description are to be had, and even where the assistance of a competent demonstrator is not to be had, the student need not despair, though, to be sure, his loss is considerable. The expense of the apparatus is always a drawback; but there is no help for it, and it is a good investment. The profitable study of almost any branch of natural science is expensive, and there seems no chance of its becoming less so. Let us hope the days will never return when a student could pass a respectable examination in botany with no other apparatus than a four-and-sixpenny text book.

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MR. I. G. RUSSELL has recently published a memoir on the existing glaciers of the United States. He gives an excellent account of what a glacier is. Some of our readers will be interested in a few condensed extracts from it.

'The formation of a glacier is due to the fact that the amount of snow precipitated in a district during a term of years exceeds the amount dissipated by melting and evaporation. Large snow banks are thus formed, the lower parts of which become compacted into ice, from the result of pressure; and, as ice is mobile by reason of its plasticity, or as a consequence of regelation, the mass of ice tends to change its form and thus acquires motion.

'The snow that accumulates on high mountains is not all melted in summer, and thus tends to increase. This becomes the *névé* of a glacier. The gorge or valley leading from an Alpine mountain furnishes an avenue of escape for the consolidated *névé* snow which flows for a greater or less distance as a stream of ice. The *névé* is composed of granular snow, which is whitish and comparatively free from dirt and stones,

since they easily sink in and become buried in the next addition. But in the region below the *névé* snow being one where the loss exceeds the supply, the snow and ice are melted and the foreign bodies formerly held in the mass are concentrated at the surface, and are then carried on as moraines, which may be lateral, medial, or terminal, according as the *débris* is deposited along the margin, in the centre (from the union of two glaciers), or at the extremity.

'In flowing through a valley, ice is subject to great stress, which often causes it to form open fissures, called crevasses. A sort of ice cascade is sometimes formed by large blocks of ice falling to the base of an escarpment. The fissures of a glacier are mostly transverse to the direction of flow, but they may take other directions, depending on the nature of obstruction and change of slope. Owing to the friction of the ice stream against the banks, the central portion flows more rapidly than the margins.

'Owing to unequal melting, the surface of a glacier is usually extremely irregular, sometimes bristling with acicular pyramids, or melted into holes and ice wells, each having a stone or mass of dirt at the bottom.

'The melting of the surface of a glacier gives rise to many rivulets and brooks, which course over it in channels of ice, frequently plunging into yawning crevasses, and finally joining the sub-glacial stream that issues from beneath every glacier. These glacier streams are always of a peculiar whitish hue, owing to comminuted rock, ground fine by the moving ice, and held in suspension by the water.

'The moving ice scratches and smoothes the rocks over which the glacier passes, while the boulders which it contains are, in turn, worn, rounded and polished.

'The records of glacial action looked for by geologists are deposits of morainal material, which often differs from the adjacent rocks in kind and arrangement; boulders perched in fortuitous positions, as on steep slopes and hill tops, smoothly rounded rocky knolls, and polished and scratched rock surfaces.'

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WE may assume that most of our readers will pay a visit to the Colonial Museum before it closes. Those who take interest in the vegetable products of our colonies will have an opportunity of seeing not only the more common and well-known vegetables and woods, but rarer specimens not so often met with. There is a fine collection from the Straits Settlements, and from British North Borneo; and also from Hong Kong and British Guiana. The food collections are sure of recognition, and they richly deserve it.

Publications Received.

Bell, G., and Sons—
A Syllabic System of Teaching to Read.
Notes of Lessons. By J. Rickard and A. H. Taylor.

Blackie and Son —
Vere Foster's Copy Books. Nos. 4, 5 and 6. (New Series.)
Mathematical Wrinkles. By Dr. W. T. Knight.
Ablett's Drawing Sheets. Demonstration Sheet, Set XI.
Vere Foster's Copy Book. No. 7.

Curwen, J., and Sons.—
Infant School Songs. Pianoforte Score.

Educational Supply Association, The—
New Certificates.

Fisher Unwin, T.—
Stops, or How to Punctuate. By Paul Allardyce.

Heywood, John—
The Excelsior Geometrical Drawing Models. By T. Jones.

Laurie, T.—
Education. June.

Longmans and Co.—
Longmans' Magazine. July.
Plane Trigonometry. By the Rev. J. Warren, M.A.
Longmans' School Geography. By G. G. Chisholm, M.A., B. Sc.

Nelson, T., and Sons—
The Royal Star Readers. Nos. 1, 2, and 3.

Philip, G., and Son—
Musical Drill for Infants. By A. Alexander.
The Complete Examiner in Geography. By J. L. Richardson.

Reid Bros.—
Eudora. By Ciro Fasoli.
Sweetly the Nightingale. By W. C. Newsam. } Music.
Evensong. By Claude Melville.

Smith, Elder and Co.—
The Cornhill Magazine. July.

Swan, Sonnenschein and Co.—
Little Asker. By J. J. Wright.
British Fungi, Lichens, &c. By E. M. Holmes and Peter Gray.
1750 Examination Questions on English History. By Oxon.

Whittaker and Co.—
Lange's German Classics. Der Bibliothekar, Moser.

The 'Practical Teacher' Sale and Exchange Column.

Owing to numerous requests, we have been induced to start this Exchange Column for the benefit of our readers. We shall be glad to insert announcements relating to the 'Sale or Exchange' of books, etc., at the rate of ONE PENNY PER LINE, *prepaid.*

For Sale :— Faunthorpe's Physical Atlas (4s.), 2s.; Piper's Advanced Arithmetic (3s. 6d.), 2s.; Morell's Grammar and Analysis, 1s. 6d.; Philip's Atlas of the British Empire (3s. 6d.), 1s. 9d.; 'Derriere les Haies,' Vol. IV., Hachette's Modern French Authors, 1s.; Lennie's Grammar, 9d.; Piper's Mental Arithmetic, 9d.; Hullah's Time and Tune, 9d.; Cornwell's Geography, 1s. 3d.— Address, Schoolmaster, Lamerton, Tavistock, Devon.

C. A. Stanyer, 30, New Gate Street, Chester, will exchange Vol. V. of THE PRACTICAL TEACHER (having two copies), for volumes either I., II., or III.

Notes of a Lesson on the Eclipses of the Sun.

BY JOS. H. COWHAM, F.G.S.,

Lecturer on School Method: Westminster Training College.

INFORMATION ARRANGED UNDER HEADINGS.

A. Simple Experiments with Shadows.

1. If an opaque object, like a paper screen or a wooden ball be placed between the eye of an observer and a lamp globe either the whole or the part of the globe will be hid from view.

2. When the ball is placed so that the eye is above or below a line running through the centre of the globe and the centre of the ball **a partial view of the globe like that in Fig. 1. will be obtained.**

NOTE.—Vary the position of the eye, and notice the change in the illuminated portion of the lamp.

3. If the ball be placed so that the eye is in the line AB., and at a distance from the ball less than the length of the shadow cone **none of the globe will be visible.**

NOTE.—Gradually withdraw the eye until at A the lamp is just visible as a rim of light.

4. If, on the other hand, the ball be placed so that the eye is in the line AB., but at a distance greater than the length of the shadow of the ball, **the globe will appear like a bright ring encircling the ball.**

B. General truth from above experiments.

The appearance of the lamp varies with the change in the position of the screen or opaque ball.

C. Application of these effects in explanation of Solar Eclipses.

1. The Moon in revolving round the Earth comes between the Sun and Earth once every month, *i.e.*, at New Moon.

2. The Moon, therefore, can act like the ball in the above experiments and eclipse the Sun only when it is **New Moon.**

ILLUSTRATIONS, TEACHING HINTS, &c.

1. Refer to common experiences, such as objects in front of a fire, hiding the light. Then with an ordinary lamp and a mounted screen or ball allow the class to perform the following experiments.

Fig. 1.—Showing the appearance of the lamp globe when viewed from E, and partially hid from view by the opaque ball M.

Fig. 2.—Showing the lamp globe entirely hid from view at E.

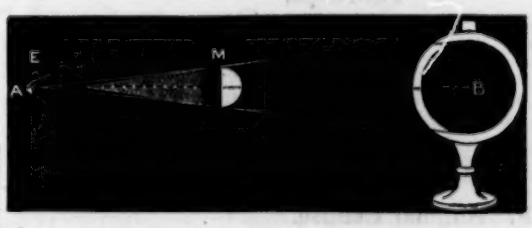

Fig. 3.—Showing the ring of light surrounding the ball M as seen from E.

If the truth is not stated by the class make it clear by repeating the experiments and measuring the distance of the globe from the eye at each experiment.

(1) and (2) For Diagram illustrating the positions of the Moon at New and Full Moon, see lesson on the Phases of the Moon. That Diagram should be introduced at this stage of the lesson.

3. It does not eclipse the Sun every month at New Moon for the same reason as that given in the lesson on the Eclipse of the Moon. **It eclipses the Sun only when New Moon occurs at or near the Nodes.**

Fig. 4.—Shows why the Moon is not eclipsed at every Full Moon. Put the Moon in that part of its orbit suitable for New Moon, *i.e.*, at D, directly between the Earth and the Sun, and it will be seen that in Fig. B the Sun **would be eclipsed**; but in Fig. A **it would not be eclipsed** when New Moon occurs, because then the Moon must be midway between the nodal points C and D.

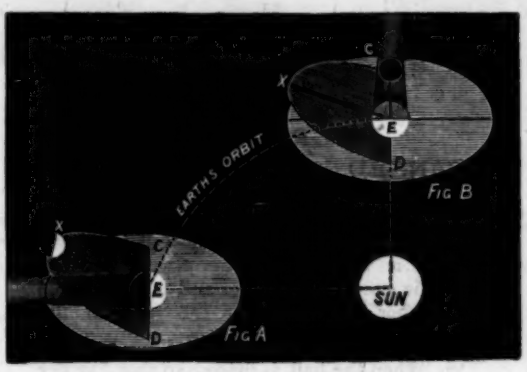

FIG. 4.

D. Total Eclipse of the Sun.

When the Moon's cone of shade reaches and covers a portion of the Earth, then to any observers placed within the area covered by the shadow, the Sun will be totally eclipsed.

This area is never very large, and in consequence a Total Eclipse of the Sun is a rare occurrence at any one place.

E. Partial Eclipse of the Sun.

Places immediately beyond and at considerable distances around the area of total shade, will be able to see portions of the Sun's bright disc. To these observers the Eclipse is said to be partial.

The area over which the partial eclipse is visible is much larger than that over which the eclipse is total. Hence a partial eclipse occurs more frequently at any one place than a total eclipse.

The following diagram shows the relative positions of Sun, Moon, and Earth favourable for both partial and total eclipses. Frequent reference must be made to the simple experiments already shown the class. By this means alone can the diagram illustrating the phenomena of solar eclipses be understood.

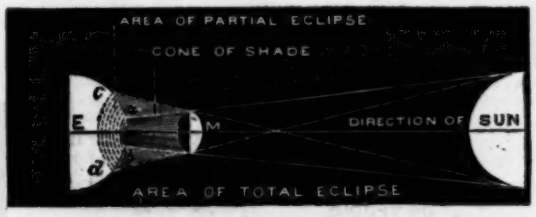

Fig. 5.—Diagram showing the causes of total and partial eclipse of the Sun. E = Earth, M = Moon.

For **Total Eclipse** compare Fig. 2 with the appearance of the Sun to an observer on the Earth's surface immediately in the cone of shade *a b*.

For Partial Eclipse compare Fig. 1 with the appearance of the Sun to an observer on that part of the Earth's surface covered by the penumbra *c d*.

F. Annular Eclipse.

When the Moon's cone of shade does not reach any portion of the earth's surface, places immediately under the apex of the cone see the sun like a bright ring surrounding the opaque moon. This appearance is called an **Annular Eclipse.**

The Moon's shadow sometimes reaches the earth, giving then a total eclipse (Fig. 5), and sometimes it does not reach the earth, yielding then an Annular Eclipse (Fig. 6). This is due to the Moon's course round the earth being elliptical instead of circular. In the diagram Fig. 7, M_1 represents the Moon much nearer the Earth than M_2. In the former position the Moon is in *perigee*, in the latter position it is in *apogee*.

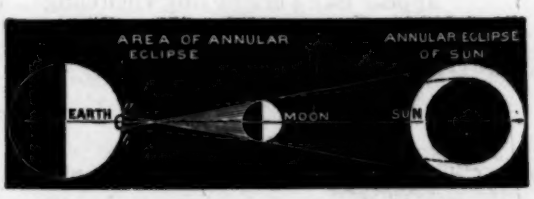

Fig. 6.—Illustrating an Annular Eclipse. Compare Fig. 3 with the ringed shape appearance presented by the Sun to an observer on the Earth's surface within the area marked *a b*.

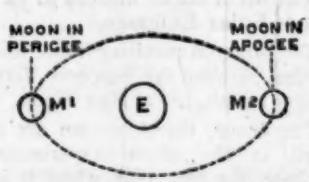

Fig. 7 shows the varying distances of the Moon from the Earth This accounts for the shadow sometimes reaching the Earth and sometimes not reaching the Earth.

G. Revision.

1. Contrast between Eclipses of the Sun and Moon

(*a*) Lunar Eclipses occur at Full Moon.	(*a*) Solar Eclipses occur at New Moon.
(*b*) Can be seen over one half the world at the same time.	(*b*) Only visible over very limited areas at one and the same time.
(*c*) May be some hours in duration.	(*c*) Generally only a few minutes in duration.
(*d*) Caused by the Moon entering the Earth's shadow.	(*d*) Caused by the Moon's shadow reaching towards, or covering a portion of the Earth's surface.

2. Comparison between different eclipses of the Sun.

A total or a Partial Eclipse occurs when the Moon is (*a*) New, (*b*) near its Node, (*c*) in **Perigee.**

An Annular or a Partial Eclipse occurs when the Moon is (*a*) New, (*b*) near its Node, (*c*) in **Apogee.**

Publications Reviewed.

Royal Star Readers. Nos. I., II., and III. London and Edinburgh: T. Nelson and Sons.

The publications of this house are so well known, and so highly appreciated, that the very name would be sufficient to ensure their acceptance in any part of the world. The Royal Star Readers are produced on the same lines as others of their School Series. Binding, printing, and illustrations are all that can be desired. The matter is almost entirely new, and consists of stories, lessons about animals, plants, and common things, interspersed with poetry old and new. Lessons on thrift, kindness to animals, obedience, and industry, are found in all the books. Standard I. has script exercises, white on a black ground, so arranged that there is practice in all the letters, capital and small. In it also the words of the primers of the same series are repeated so that the revisal of former lessons is easily accomplished. This feature is continued in other volumes. Standard II. repeats the lists of words from Standard I., and Standard III. those from Standards I. and II. Exercises in Grammar, a sufficient number of pieces of poetry suitable for recitation, and the necessary lessons in Grammar, make the books entirely suitable for the English of the Code. We can heartily commend the Royal Star Readers as equal in all respects to the other publications of this famous house.

Examination Certificates. Educational Supply Association, Holborn Viaduct, London, E.C.

The Educational Supply Association have forwarded to us copies in various sizes of two very chaste designs for Certificates for passing the Examination by Her Majesty's Inspector. The colours are beautifully blended and free from objectionable features.

One of the designs can be had without the printing, and can thus be used either for other purposes or can be printed locally. Teachers would do well to examine these before deciding what to get when their examination comes round.

Mathematical Wrinkles. By Dr. W. T. Knight, F.S.Sc. London: Messrs. Blackie & Co.

Professors and Examiners, we know, dislike exceedingly titles to books which imply that their examination papers contain anything but perfectly straightforward and fair questions, in which there are no catches to avoid, and which require nothing but a thorough knowledge of the principles and applications of the science: at the same time, no one can doubt the value, from a commercial point of view, of a taking title which removes or seems to remove the treatise from the ordinary lines of text books.

In these days when new treatises on Arithmetic, Algebra, and Geometry, are coming out every month, if not every week, unless a man has made a great name for himself as a writer of such books, it is but scant notice or patronage he can hope to secure from the press and the public, unless it professes to be something quite out of the ordinary run; and in no way can he do this so easily as by giving it some taking title.

Now though we all know what is understood by a 'Wrinkle' for an examination, the derivation or origin of the word seems to be doubtful. Dr. Knight in his preface speaks of 'wrinkles'—which he inserts between inverted commas—not as the assistances, as they are generally understood, but as the difficulties, or literally roughnesses, it is the teacher's duty to point out to his pupils; but the book would seem to be an attempt to smoothe over these roughnesses, and how he has done this we will now proceed to show.

The little work consists of last January's (together with the five preceeding) Arithmetic, Algebra, and Geometry papers, set at the examination for the Matriculation at London University. These twelve papers are fully solved, and to the majority of the solutions there are notes referred to, which notes are collected together at the end of the volume and constitute no less than nearly half of it. We have no hesitation in saying with the author, these notes are the most valuable part of the work. Sometimes in them he generalises the method adopted in the solution, at another he gives another solution altogether, and in the Geometry, he often proves the converse theorem or states the analysis of the problem.

We are bound to say that we think Dr. Knight has given far more valuable aid in Geometry than in Arithmetic or Algebra.

In some of the solutions of the questions given in the last named branch of study we should doubt very much if Dr. Knight would get full marks for them. For instance here is a problem, set in January, 1882: A sets out to walk from London to Rugby, and B at the same time from Rugby to London, a distance of 84 miles, and A reaches Rugby 9 hours, and B reaches London 16 hours after they meet on the road. Find in what time each performed the journey, and their rates of walking, supposed uniform. Dr. Knight uses no less than three symbols, whereas the problem can be easily solved with only one. We are willing to grant that his equations are very simple, but surely it is more schorlarly to use as few symbols as possible, and Examiners who mark for style no less than for correctness would, we believe, take this into account.

Again, though Dr. Knight has published a book called 'Algebraic Factors,' in which we presume he has treated the subject of symmetry, he misses the very simple method of finding the value of

$$(x+y+z)^2+(x+y-z)+(z+x-y)^2+(y+z-x)^2$$

which we should have thought any one who had studied symmetry would have at once perceived.

In the notes on the Arithmetical part of one of the papers we were much pleased with the lucid way in which the rule called 'Cause and Effect' was explained.

In the Geometrical solutions the figures are, with one exception, omitted, but not, so the preface tells us, for the students' mental advantage, but simply to cheapen the cost of production, and lessen the price of the book.

Considering that the book now costs very nearly one farthing a page, which we fancy is a long way above the average of the present price of such manuals, we are somewhat astonished that such liberal and thorough publishers as Messrs. Blackie allowed such a sentence to appear in a book coming from their house. At the same time we rejoice that the figures are not there, as it is infinitely better for a student always to draw his own.

The solutions of the questions in Geometry often suggest to Dr. Knight a set of problems. This ought to teach any thoughtful student how he may, in working at problems, discover fresh ones and thus amass a considerable collection.

We can well understand the little volume being of considerable use to a young man preparing himself for the examination, the papers of which are here solved, but we cannot think it will be of much value to teachers or to those undergoing a course of lessons with a capable tutor.

As to its get up, printing, &c., it is in Messrs. Blackie's usual style, which every one knows to be all that could be desired.

Elements of Plane Trigonometry. By Rev. Isaac Warren, M.A. Longmans and Co.

The author of this little manual, who is a mathematical scholar of Dublin, believes that it will supply the want of a 'Treatise on Trigonometry, containing the main facts of the science, unencumbered by unnecessary details.'

In a work of this kind it is perhaps unfair to look for anything new excepting, perhaps, in the order and arrangement of the matter and in the method of its exhibition; and here we gladly acknowledge that the former thoroughly commends itself to us, and that the latter is as good as possible. By the use of different type the propositions are practically analysed into their different constituents, the proposition itself being clearly distinguished from its proof.

The second edition is enriched by some entire examination papers as given at the examinations at Dublin, Woolwich, and Sandhurst, and when a question, taken from a public paper, is embodied in the sets of questions at the ends of the chapters, its source is printed at the side.

Mr. Warren, on the authority of Professor James Thomson, adopts the title 'radian,' with the symbol R, as the unit of circular measure—but with the exception of the name we do not see anything particularly new in his treatment of this branch of the subject, as promised in the preface.

We are surprised to find that there are no geometrical proofs for such formulæ as Sin 2A, tan (A + B), $\tan \frac{A-B}{2} = \frac{a-b}{a+b} \cot \frac{c}{2}$ or even $a = c \cos B \times b \cos C$.

We are quite sure that students love to be able to prove geometrically formulæ they have arrived at analytically, to say nothing of the fact that such proofs are often asked for. Only the other day we saw a geometrical proof of $\cos 2a = \cos^2 a - \sin^2 a$ asked for, and that in quite an elementary paper. Students, moreover, are far less likely to forget that which they have arrived at by more than one mode of reasoning.

We noticed that the inverse notation was introduced tolerably early in the book, but that it was worked in the old fashioned way, viz., by substitution. On this subject the author asserts that the notation is suggested by considering sin, cos, tan, &c., as co-efficients. We believe Colenso was the first to show this accidental connection, but, unless a student thoroughly realises that it is accidental, he will be very apt to lose his idea of a goniometrical ratio; and it is in this want of a clear conception of a ratio that the great difficulty of Trigonometry consists; but Mr. Warren, we are glad to add, has taken a great deal of trouble in the earlier part of the book to show the true nature of these ratios, how that they are abstract, or, as he calls them, 'pure' numbers, and therefore capable of having any operations performed upon them.

In the chapter on triangles we think references are required to show where the different formulæ used were proved, and, as we said before, some geometrical proofs might with great advantage be given.

The chapter on heights and distances is very short, only containing three problems and some 22 or 23 examples.

The less interesting parts of the science are wisely pushed to the end of the book, and an entire chapter is devoted to the necessary but puzzling operation of elimination. It is wonderful how many students there are, who can solve problems of a more practical kind, whose manipulative skill is so weak that they fail in the simplest eliminations.

There are three appendices, viz., one on logarithms (not including the exponential theorem, nor logarithmic series), in which the practical use of logarithmic and other tables is well explained; a second on the mariner's compass; and a third, to which we have already alluded, containing some seven papers as actually set to freshmen and others at Trinity College, Dublin, and eight as set at Sandhurst and Woolwich, with answers or hints as to the solutions of the questions. We think Mr. Warren has erred, if he has erred at all, on the side of care not to 'cumber' his book with unnecessary details.

We trust that there are few examinations, at universities at any rate, which will not be so developed in the course of a few years as to render such a book as this almost useless. As matters at present stand, no doubt many wishing to pass an elementary paper in this science would not only find all that they actually require, but also find it put in an intelligible and useful way. We must add a line as to the clearness of the figures and the beauty of the printing.

Public Examination Scripture Manuals. St. Luke's Gospel. By Arthur Riches, F.R.A.S. Relfe Brothers.

This work consists of Questions (actually set in the Oxford, Cambridge, and Durham Local Examinations, and also in those held by the College of Preceptors) carefully answered. To every question is appended initials, to show where the question came from.

These questions are arranged, as far as possible, in the order of the Gospel itself, under the numbers of the chapters.

At the end there are some 12 or 13 pages of more various questions, about the feasts, for instance, special prominence to prayer, which could not be classed under one of the chapters, and these are followed by a list of the names mentioned in the Gospel—both of people and of places—with short notes as to meanings, locality, and incidents.

There are also some lists and a carefully devised index, in which such words as bottles, cubit, treasury, &c., are classed by themselves at the end.

In the preface the author says "he hopes that the book may *not* be used until *after* a thorough preparation and sound teaching have been given to the pupil.' It is only '*then*, he adds, after a subject has been mastered, that a book of this character is most essential for strengthening a candidate's memory for necessary fact and detail; although, if judiciously used previous to this, its great aid will be readily recognised."

We quite agree with the author in the former part of this assertion, but we very much fear whether the number of teachers will be large who will so use it.

Some old fashioned teachers would object to the book very much as doing a great deal too much for the student and almost destroying the subject treated of as an educational one. We must never forget children ought to go to school to be educated, not merely instructed.

For those who will, however, conscientiously use it, it will be found of great use; the questions being very exhaustive, and the answers models of concisely expressed information.

Numerical Examples in Heat. By E. R. Day, M.A. Longman and Co.

Many teachers and students remember a collection of examples in Heat by Mr. Day. It was an excellent collection, but beyond the answers no assistance was given. The present Edition is enlarged from 48 to 176 pages and contains so many additions and improvements that it is for all practical purposes a new book. The most striking feature of the present volume as compared with the last is the help given in the way of examples worked out. Students will find many of the notes most valuable. Neat and accurate methods are supplied as they are wanted and where specially difficult examples occur the author comes to the rescue at the right moment. It may be well to inform those who have not yet seen these examples that they are, many of them, of considerable difficulty and fairly cover the subject. A student who can work them correctly may be certain that he has a good grasp of his subject and need be in no fear of an examination upon it. Those who intend taking the Honours or advanced papers at the May Examinations would find excellent practice in this volume.

The author's experience has no doubt confirmed what he tells us in his preface that beginners in Physics find considerable difficulty in the application of the principles of Science to the solution of problems in which a definite numerical result is asked for. He rightly reminds us that a knowledge of Physical Science which cannot be reduced to concrete numbers is no real knowledge at all. It is very important there should be plenty of practice in applying theories to the solution of such questions as they are of frequent occurrence in the subject.

Sound, Light, and Heat. By Alfonso Gardiner. Manchester: John Heywood. 14th Edition.

This is a volume of 203 pages, well printed, well illustrated and well bound. It is one of a series of Science manuals adapted to the requirements of the South Kensington Science and Art Department. This book deals only with the elementary stage of the subject. The fact that thirteen editions have been sold shows that it has answered its purpose. In the preface the author tell us that after all the improvements that have been made in the new edition it is only a 'note book,' and teachers' lectures, or the reading of advanced text books, together with actual experiments, must clothe the bare skeleton here presented. Enough matter may surely be put in 200 pages for an elementary acquaintance with the subject. The error that the author has fallen into has been one of excess rather than defect. There is throughout a slavish adherence to the syllabus; and the great aim seems to be to produce a book which shall contain answers to all the questions previously set. We are afraid this volume is a fair type of the Science text books of 15 years ago. The fundamental and insuperable objection to them has been that books have been studied, not things. Pupils have been asked to take unreal and second hand accounts when they might as easily have been taught how to deal with the real phenomena. We are gradually getting into a better state of things. Book makers will do well to notice the altered circumstances. Examiners will more and more insist on pupils observing a few simple facts, expressing what they observe in plain language and inferring simple relations between what they observe and what they knew before.

We have not space to go into a detailed examination of the book. We give a few errors. Elasticity (page 14) is said to be the property by which a body recovers its former figure after external pressure, or by which it sustains any pressure (not a good definition); and we are then told that gases are the *most elastic* bodies; liquids also are very elastic, while steel, glass, &c., possess considerable elasticity. On page 13 we read, the greater the elasticity and the less the density the greater the velocity of sound through any medium. It would follow therefore that as gases are the most elastic bodies and at the same time the least dense, that the velocity of sound would be greater in them than in liquids or solids, and greater in them that in solids. The author may well say on page 30 that there is no mistake more common than to suppose velocity of sound is augmented by density. After reading statements like these one would be surprised if it were otherwise. Rumford's photometer is said to consist essentially of a pane of *ground glass* held in an upright position. Why ground glass rather than a sheet of paper, or a whitewashed wall? The incident and reflected rays are said to be in the same plane which is perpendicular to the reflecting surface. But there is an indefinite number of planes perpendicular to a reflecting surface, which of them is it?

A boy beginning the subject needs to have the terms used thoroughly explained, the main laws clearly stated and well illustrated, and if possible proved.

In the volume before us there is far too much of what could very well be left out, and far too little of what is really useful. We find an explanation of 'luminiferous ether' but not of thermal unit; and the number 79·4C or 174·92 F (?) is called the latent heat of water.

On page 88 we are told that when both faces of a double convex lens have the same curvature the principal focus is the centre of curvature of the lens; nothing is said of the material of which the lens is composed. A boy would naturally fancy that the centre of a double convex lens where the radius of each face was the same, was at the centre of curvature, and, as we know, nothing could be more misleading. Two pages might have been devoted to a pretty full account of a double convex lens, giving, among other things, methods for finding the focus. Instead of that we have meagreness and inaccuracy combined.

Lecture Notes on Sound, Light, and Heat. By Charles Bird, B.A., F.G.S.

The author has published these notes to form the groundwork of a course of lessons which should be illustrated by experiments and followed up with questions and problems. It would thus appear that this pamphlet of 60 pages is intended for young and inexperienced teachers. And we are not sure whether they may not profit by perusing it. The notes seem to us not condensed enough for pupils, and not complete enough for teachers. The attempt to cover so wide a field in a few pages must necessarily be unsatisfactory. It would be a thousand times better to take a few points and make them thoroughly understood. The subjects chosen do afford opportunity to observe, study and measure some very important quantities. But when entities like density and elasticity are merely introduced to explain velocity, and then dismissed, it is pretty certain they had better not have been introduced at all. There is need to revise the formulæ employed. The number of vibrations (per second we suppose) is said to be $= \frac{\sqrt{w}}{lr\sqrt{d}}$ which, to say the least, needs explanation. The law for the refraction of light is stated correctly. The law for the reflection is not quite accurate; there are many planes perpendicular to the reflecting surface; which one is not mentioned. Parkinson puts the matter quite clearly; why not follow him?

On page 28 there are two important errors. The position of the image and object for a given lens are said to be determined by the equation—

$$\frac{1}{v} - \frac{1}{u} = \left(\frac{1}{r} - \frac{1}{r'}\right)(\mu - 1)$$

or, if the conditions are given, by the formulæ

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

two mistakes very commonly made.

If in a second edition all the advanced points are omitted, and the whole carefully revised, and, where necessary, corrected, it may be much more useful than at present. We cannot recommend it as it now appears.

A Manual of Mechanics. By T. H. Goodheve, M.A. Longmans and Co.

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